THE ETHER AND ITS VORTICES

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PREFACE

It is often stated that the function of science is to make observations and measurements and to find correlations between the observed facts. That such pursuits belong properly to the realm of science cannot be disputed, but science is not limited to purely empirical or inductive methods of investigation. Any procedure by which the facts of nature can be ascertained or surmised or rendered more intelligible and less mysterious deserves to be recognized as a truly scientific pursuit, and by "facts" is here meant not only objective facts but also subjective or psychical conditions.

Modern physics is devoted largely to the use of mathematical symbols and equations, but the success of this method does not justify us in condemning the use of geometric forms and models as unscientific. Mechanical and hydromechanical models are based primarily on geometric or space relationships, and geometry, even solid geometry, is a branch of mathematics—a fact too often ignored by the exponents of "the new physics". These considerations are especially pertinent in the field of atomic structure where geometric relationships must be presumed to be of primary importance although hidden from direct view and in many cases not easily expressed by mathematical equations. Physicists may be correct in their assertion that nothing is truly scientific unless it can be expressed mathematically, but the writer maintains that no system of atomic structure is truly scientific unless it can be expressed geometrically by pictures or diagrams—"structure" by its very definition being something that must have geometric form.

There has been much philosophical argument over whether the external world really exists, and whether the expression "physical reality" has any meaning. If we adopt the idealistic view of Bishop Berkeley and Immanuel Kant that matter does not exist as an objective reality but only as a product of the mind, then the primary purpose of theoretical physics should be to study mental processes rather than physical phenomena so as to ascertain the clearest and most satisfactory symbolic representations of the facts of nature by means of mathematical formulas and equations. This is exactly the attitude that is taken by the leading physicists of today, with the result that nearly all recent books on quantum mechanics and atomic structure are couched in such language that it is impossible to tell where the world of physical reality ends and where the world of mathematical fancy begins. If we ask any exponent of "the new physics" whether the elec-

trons actually move in orbits about the atoms, we will probably get a lesson in jesuitism for a reply, but never any direct answer of "yes" or "no".

On the other hand if we adopt the materialistic view of the general public that matter does exist of its own accord, then the primary purpose of theoretical physics should be to ascertain the true facts of nature, regardless of whether or not they will readily lend themselves to mathematical treatment. For example in the case of atomic structure the Bohr atom with its planetary electrons travelling in a grooved ether will lend itself to mathematical treatment more readily than the new vortex atom with its complex system of circulating ether currents, but the latter is probably a closer approximation of what actually exists in nature. This difficulty of expressing vortex structures mathematically was recognized by A. A. Michelson (1911, p. 162) when he wrote that

> The mathematics of the subject is unfortunately very difficult, and this seems to be one of the principal reasons for the slow progress made in the theory.

The writer takes the materialistic view for granted and in the present book will proceed with the assumption that the external objective world really exists. The vortex atom structures herein presented purport to be at least approximately true representations of what actually exists in nature, and not merely convenient symbolic fictions. This is more than can be conscientiously claimed for the Rutherford-Bohr atom.

The fourth chapter in which mind and consciousness are discussed will probably not meet with the approval of the religionists who would prefer to have everything that is of a spiritual nature remain shrouded in mystery and enveloped in an atmosphere of supernaturalism so that it can be used more effectively to overawe a credulous and bewildered public. Although it is conceded that mind and consciousness are in the field of religion, nevertheless the writer maintains that everything of a psychical character, including morals and ethics, is also properly within the field of science. If scientists should not have the privilege of deciding what shall be included in the field of science, then why should religionists have the privilege of deciding what shall be included in the field of religion?

Whether the human mind is merely the subjective aspect of the living organism or is a separate soul-like entity which survives after death, and what the relation of the mind or soul is to the all-pervading ether, are questions which not only may be, but must

be considered in any thorough-going treatise on ether mechanics. The fact that the complex physicochemical processes which give rise to mental activity are not yet as completely understood as some of the simpler mechanical processes is no reason for excluding these more complex and less understood processes from the field of science, because, as Herbert Dingle (1944) tells us,

> It is not fair to insist on a rational explanation of easy things and fall back on supernaturalism for the difficult ones. If we bring in supernatural agencies at one point we may as well bring them in at all points, and save ourselves the trouble of constructing a trivial man-made order.

Although an entire chapter of this book is devoted to the relation of mind or consciousness to the ether, there is nothing said about the relation of God to the ether. The reason for this discrimination is that we all know what is meant by mind or consciousness but there is no unanimity of opinion as to what is meant by "God" or whether such a being actually exists. To say that God is "a spiritual being" does not mean much unless we define both "spiritual" and "being". There is really not an iota of evidence nor any principle of logic which gives the slightest support to the hypothesis of a God. The "awareness" of God which some people claim to be gifted with is nothing more than an awareness of their own consciousness—an awareness of their inner sense of well-being. Neither is the hypothesis of a God supported by any considerations of cause and effect. If it be argued that the ether itself must have been originally created by some God, then to be consistent it would also have to be argued that this first-mentioned God must himself have been created by some older God, and so on *ad infinitum*. On the other hand if it be argued that a God may be eternal, then it could also be argued with equal propriety that the ether itself may be eternal, there being no evidence that the world as a whole ever had a beginning or ever will have an end.

The existence of the world is not explained by the *ad hoc* assumption that it was "created" at some definite time in the past. Such an assumption only substitutes a greater difficulty for a lesser one. By the term "world" as hereinabove used is of course meant the world as it exists at this instant, and the existence of this present world is adequately accounted for by considering it to be the necessary consequence of the world as it existed at the instant immediately preceding, and so on back *ad infinitum*. Nevertheless the inquisitive reader will probably ask:

"But why should there be any world at all, instead of utter nothingness?". The answer is that a state of utter nothingness would correspond to a perfectly quiescent ether, whereas a state of physical reality with a world in existence corresponds to a turbulent ether. Quiescence and turbulence are different statistical states, and although there can be only one state of quiescence, there can be an infinite number of turbulent states. A turbulent ether is therefore infinitely more probably than a quiescent ether, and in physical systems which are governed by the principles of statistical mechanics it is always the most probable condition that actually exists in nature. Hence if the entire world would be completely eliminated, it would be instantly regenerated of its own accord. A God is not necessary to bring about that which will follow as a matter of mathematical necessity. This was recognized not only by Laplace but also by the ancient Greek atomists.

It has however been suggested that ether itself may be the mysterious God in question, but such a pantheistic doctrine would unduly distort the established meanings of these terms. The God of past history, who is still being worshipped in all the churches of today, was definitely a personal if not an anthropomorphic God. People do not say prayers to the laws of physics, or worship the principles of chemistry. Any interpretation of the ether as "God" would only lead to confusion.

Nature is psychical as well as physical, and during the process of evolution psychical development takes place simultaneously with physical development. It could not be otherwise because the psychical is the subjective aspect of that of which the physical is the objective aspect, and the one is just as real as the other. Both are attributes or aspects of nature, and more specifically of the ether. A God however must be something separate and distinct from nature because we all believe in the existence of nature, but with all due respect to the German composer Bach, we do not all believe in the existence of a God. Nevertheless the reconcilers are still making desperate efforts to interpret God as an attribute or aspect of nature so as to harmonize science with religion, but such an interpretation is neither scientific nor religious. It only shows how utterly impossible it is to bring about the desired reconciliation.

C. F. K.

THE HYDROMECHANICAL ETHER

For several decades the physics profession has been contending that the hypothesis of an ether serves no other purpose than to supply a subject for the verb "to move" or "to undulate". There are however many other things in nature besides movements and undulations. There are at least three elementary forces which act at a distance, namely gravitational, electric and magnetic forces, and also at least three different subatomic particles, namely protons, electrons and neutrons of which all matter is composed. The modern physics profession with its etherless universe has not yet given us a satisfactory explanation for a single one of these elementary forces or subatomic particles, but we do have such explanations under the new vortex theory which would have no meaning or significance and would never have been thought of without the assumption of an ether.

It may be true that the existence of an ether has never been proved within a strict meaning of the word "proof", but we do have an abundance of indirect evidence of its existence, and certainly its existence has never been disproved—not even by the Michelson-Morley (1881-1887) experiment. On the contrary, the positive first-order results obtained in the Sagnac (1913) experiment, and also in the Michelson-Gale (1925) experiment, would be difficult to explain on any other basis. If we were to deny the existence of an ether, then we would also have to deny the existence of the world because there could not be any world unless there exists some substance of which the world is composed. Furthermore the ether must be something which occupies space and is capable of moving so as to have fluidity which reduces it to a hydromechanical ether, but not necessarily to the completely frictionless and nonviscous ether of the 19th century.

The concept of a single primordial substance can be traced at least as far back as Anaximander (611-547 B.C.) whose "Infinite" corresponds in every respect to the present-day concepts of the ether. Anaximander was closely followed by Heraclitus (535-475 B.C) whose "Fiery Ether" had the same general significance as the Infinite of Anaximander but with a more dynamic aspect, thus resembling more closely the dynamic vortex ether which was later revived by René Descartes (1596-1650) in his theory of celestial vortices. Soon thereafter Johann Bernoulle (1667-1748) deduced Kepler's laws from Descartes' theory of vortices, but in the meantime Isaac Newton (1642-1727) had introduced his mathematical

theory of gravitation and his corpuscular theory of light, both of which were based on the assumption that free space was completely empty and not filled with a dynamic ether as assumed by Descartes. Some time later Michael Faraday (1781-1867) made use of an elastic solid concept of the ether, after which J. C. Maxwell (1831-1897) revived the ether vortex theory in the field of electromagnetism, and George Stokes (1819-1903) then sponsored a dynamic ether concept which could have been easily reconciled with the ether vortex concept of Descartes. Headed in the opposite direction, and in line with the Newtonian empty space idea, was the stagnant ether theory of H. A. Lorentz (1853-1928), a close forerunner of the Poincaré-Einstein theory of relativity. The Michelson-Morley experiment in 1881 however proved that the Lorentz theory of a quiscent stationary ether was wrong. A choice then had to be made between a dynamic interstellar ether as conceived by Descartes and Stokes, or merely empty space without any ether as conceived by Newton and Einstein. The Einsteinians have prevailed thus far and are still in the majority, but the question is still being argued and is by no means settled.

The ether with which the 20th century vortex theory deals is a new type of hydromechanical ether which does not contain any atomic oscillators and is therefore free from ordinary frictional viscosity, but which does have a sort of idealized or quasifrictional viscosity by virtue of which its direction of flow is controlled, without any dissipation of energy. A body which is moving through such a fluid will continue to move at constant velocity in accordance with Newton's first law of motion. Any portion of the fluid which is in its path will be deflected around it so as to form an enveloping vortex that moves along with the body (see Hilgenberg, 1939). If the fluid has mass and inertia, as presumably every fluid must have, then such a moving body would have to do work upon the fluid ahead of it to push it out of the way, but the deflected fluid after bypassing the body will immediately return its kinetic energy to the rear side of the same body. A portion of the kinetic energy of the moving body will therefore be contained in the fluid vortex which moves along with the body, but the total kinetic energy of the moving system will remain the same. This is exactly the behavior that would be required of an interplanetary ether which permits the planets to move freely through it but which is also carried along locally by the moving planets so that there will be no observable ether drift along the surface

of any planet, except that which is due to the rotation of the planet on its axis.

Such a quasifrictional concept of the ether may have been inherent in Descartes' theory of vortices, but its importance was not fully appreciated until the early part of the 20th century when it was vigorously sponsored by Hermann Fricke in Germany at about the time when Poincaré and Einstein introduced the special theory of relativity. It has the advantage over special relativity in that it represents a system which can be visualized whereas special relativity cannot be visualized but can only be expressed mathematically. Special relativity is therefore only a mathematical evasion and not an explanation. The failure of physicists to recognize that there can be a quasifrictional viscosity without any thermal dissipation of energy has been one of the most serious mistakes which they have made during modern times. Such a concept is not self-contradictory but can be illustrated by a fish gliding through the water under its own inertia, the frictional dissipation of energy in such a case being negligible. It is also illustrated by the flow of electrons along a superconductor at a temperature near absolute zero where the atomic oscillators have settled down to such a degree of quiescence that they are no longer aroused to activity by the migration of the electrons.

A purely hydromechanical interpretation of the ether is generally thought to be inadequate to acount for the elementary particles of matter with their associated fields of force, or for light waves with transverse displacement, but as long as we have not yet made any exhaustive study of frictionless hydromechanics, we are not justified in summarily rejecting such a concept as inadequate.

The presence of a transverse displacement in light waves does not necessarily preclude the possibility of a longitudinal displacement. The transverse displacement may have been accentuated at the expense of the longitudinal displacement by passage through the polarizing apparatus. It has been shown by R. Wussow (1925) that such a transformation is conceivable, but if light waves do have such a longitudinal displacement, then the ether would have to be accredited with at least a limited compressibility. An infinitely compressible ether is so difficult to form any clear concept of that it may be left out of consideration. It is doubtful whether light waves could travel with a finite velocity in an infinitely compressible ether, and vortex motion could not exist therein. The ether must be either entirely incompressible, or must have only a limited compressibility. Since our experience

with material systems has taught us that compressional elasticity is always associated with bodies consisting of discrete elementary particles, it seems that a primordial substrate like the ether which presumably does not have any atomic constitution could also not have any compressibility.

In the absence of any atomic oscillators, an incompressible ether with any viscosity at all, and especially with an *inertial* viscosity of the type hereinafter described, should be capable of transmitting waves with transverse displacement. Such waves, when they occur in a fluid medium, are generally referred to as "electromagnetic" rather than hydromechanical, but as will be explained in detail later, electromagnetism can itself be reduced to a hydromechanical basis.

The term "viscosity" has been used hereinabove with reference to the ether so as to conform to the terminology which is now in general use, but in the physics literature of today this term is usually applied to material fluids which have internal friction and are capable of thermal dissipation of energy. For describing a frictionless fluid like the ether, we should use a term with a broader meaning so as to be applicable to the idealized viscosity of the ether in which the resistance to motion is not caused by internal friction due to presence of atomic oscillators, but by the *inertial* reaction of the surrounding fluid. The term *viscidity* seems to meet this requirement, and will henceforth be used instead of "viscosity" in referring to the ether.

The viscidity of the ether is not frictional viscidity resulting from any complex internal structure of the ether, but is inertial viscidity such as is necessarily present in any fluid which is capable of moving, and a fluid which is not capable of moving is inconceivable. Since inertia itself is therefore merely an aspect of motion, it necessarily follows that a viscidity of the kind that exists in the ether is also merely an aspect of motion. It is due to the inertial continuity of the motion itself, and without such inertial continuity there could not be any motion at all. The 19th century ether which did not have any viscidity was therefore a theoretical impossibility. An ether with viscidity is the only kind of an ether that is conceivable.

Although the density of the ether, according to O. C. Hilgenberg, is only about 0.027 milligram per cubic centimeter, it must have a very high viscidity in order to transmit waves with the velocity of light. If any ordinary liquid consisting of atoms or molecules would have a proportionately high viscosity, then the

internal frictional losses would be too great to permit any effective propagation of waves, but if the ether has any internal friction at all, then such friction must be so slight as to be noticeable only as the red shift of the spectra of distant nebulae. Certainly the ether does not have any atomic oscillators in it and would therefore be incapable of any dissipation of energy in the form of heat. Any work that is done upon any portion of the ether could be spent only in overcoming the inertia of that portion. No matter how great its viscidity may be, there would still be complete fluidity. High viscidity and complete fluidity are not contradictory or mutually exclusive properties because complete fluidity requires only that there must not be any internal friction, either static or dynamic, whereas high viscidity of the kind that exists in the ether requires only that internal displacements be propagated laterally, and such lateral propagation does not depend on frictional dissipation of energy. The hydromechanical concept of the ether is not as contradictory as some of the substitutes that have been offered for it, as for example Einstein's second postulate of relativity. All electric and magnetic action at a distance is proof of the internal viscidity of the ether, and such viscidity is easier to visualize than light waves whose velocity relative to the observer remains the same, regardless of whether the observer is moving toward or away from the approaching waves.

Before we reject the concept of a hydromechanical ether as inadequate we should also give consideration to the fact that we know only very little about the motion of fluids where sources and sinks are present, which includes vortex motion, every vortex ring having associated with it a source on one side and a sink on the other side. In ordinary liquids and gases such vortex motion rapidly disappears because of internal friction, but in an ether that does not have in it any atomic oscillators and therefore no internal friction, such vortex motion and the sources and sinks associated therewith would be perpetual regardless of how great its viscidity may be. A high degree of viscidity may have its effect on the forms and dimensions of the vortices, but would not cause their destruction or prevent their existence if the viscidity is due to inertial reaction and not to internal friction.

The opinion has been expressed by Einstein and others that the concept of motion, although applicable to all molecular and corpuscular fluids, is not applicable to a homogeneous and structureless fluid like the ether. It seems however that this objection is without merit because the concept of motion is complete in itself

regardless of what it is that moves. We should not form too materialistic a concept of the ether because it is not a *material* substance but rather the common substrate of both matter and mind. The concept of motion has a different meaning with respect to the ether than with respect to material substances because a material substance remains in existence after its *observable* motion has ceased, whereas the ether may be of such a nature that it depends for its very existence on its motion. Movement of the ether is a noumenon rather than a phenomenon and therefore cannot be dealt with in the same manner as movement of a material substance.

An ether which is capable of moving would necessarily have inertia because inertia, although usually referred to as a property of matter, is primarily a property of motion. Inertia means nothing more than continuity of motion, and all motion necessarily has continuity as long as the motion continues. If the motion is rotation or movement in a closed circuit as in the case of vortex motion, then the inertia will be localized, and localized inertia is just another name for momentum. Hence in order to account for the elementary particles of matter, we need only have an ether that is capable of moving.

Today the hydromechanical type of ether is generally thought to be inadequate to account for the behavior of light waves under the relativity and quantum theories. Thus according to the special relativity theory of Poincaré and Einstein, which should not be confused with Newtonian or classical relativity, light waves are always supposed to travel with the same velocity relative to the observer, regardless of whether he is moving toward or away from the approaching waves, and according to the usual interpretation of the quantum theory, such waves are also supposed to remain segregated in separate bundles or "photons" instead of spreading out in all directions like sound waves. We must however distinguish between the observed facts themselves and some of the startling theories that have been introduced by physicists of the Einstein-Planck school.

The special relativity theory was offered primarily as an explanation for the Michelson-Morley experiment which has heretofore always been performed with the interferometer arranged horizontally so as to rotate about a vertical axis. Such an apparatus would respond to horizontal ether currents only, and since all horizontal directions are physically equivalent, the results have always been negative, as might have been expected. The appa-

ratus was not sensitive enough to detect the slight horizontal drift of the ether due to the rotation of the earth on its axis. As suggested by O. C. Hilgenberg (1939), the experiment should have been performed with the interferometer arranged in a vertical plane so as to rotate about a horizontal axis, it being only in the direction of the dominant gravitational forces where any substantial movement of the ether could possibly occur, but even in the vertical direction we would hardly expect any deviation from the normal velocity of light because otherwise the North Star as viewed at different hours during the night would appear to be going around in a circle. If the force of gravity is due to an inward drift of the ether, then it is probably accompanied by a simultaneous outward migration of high velocity jets as will be explained later, and these two movements probably cancel each other out in their effect upon light radiation.

The negative result of the Michelson-Morley experiment seems to have been correctly explained by George Stokes who considered the ether as being carried along by the earth's gravitational field, but the relativists insisted that Stokes' theory was contradicted by astronomical aberration, and those who were of a different opinion were simply not given a chance to be heard. For instance the German physicist L. Zehnder, after two unsuccessful attempts to get the German Physical Society to publish his article on Stokes' theory and aberration, finally had to content himself with getting it published in the ASTRONOMISCHEN NACHRICHTEN where it has remained hidden and buried in the dust ever since. Other physicists with similar views have been even less successful than Zehnder and had to depend on privately published monographs for an expression and recording of their views. If there has been anybody who was really competent to say whether the Michelson-Morley experiment has disproved the existence of an ether, then it was A. A. Michelson himself, and Michelson has always been an ardent advocate, not only of the ether vortex theory, but also of Stokes' concept of the ether.

Stokes' theory was later corroborated by both the Sagnac experiment in 1913 and the Michelson-Gale experiment in 1925. Although these two experiments have clearly disproved the Poincaré-Einstein theory of relativity, the physics textbooks of today are still confidently expounding "Einstein's theory", without ever mentioning the experiments by which that theory has been disproved.

In the Sagnac experiment two simultaneously emitted light signals were sent in opposite directions around a closed path, and a photographic plate was arranged to record the interference fringes at the place where the signals met. The entire apparatus was supported on a turntable. The results showed that when the table was slowly rotated, it took one of the light signals a longer time and the other one a shorter time to reach their final meeting place than when the turntable was not rotated. Similar positive first-order results were obtained in the Michelson-Gale experiment which showed on a much larger scale that the velocity of light at the surface of the earth is less in the direction of the earth's rotation than in the opposite direction.

These experiments seem to show that the ether at the surface of the earth is carried along completely by the earth in its orbital movement about the sun, but that it does not partake of the rotation of the earth on its axis. The reason why this rotational drift of the ether has not been detected in the Michelson-Morley experiment is because the effect is too small. The earth moves in its orbit about the sun with a velocity of nearly twenty miles a second whereas the peripheral velocity which is due to the rotation of the earth is only about one-third of a mile per second at the equator, and less elsewhere.

Stokes' theory is also corroborated by the orbital movements of the planets about the sun, and of the satellites about the planets. The sun itself moves through interstellar space, relative to the fixed stars, with a velocity of 19.6 kilometers per second, while the planets move in nearly circular orbits about the sun. The planet Jupiter for example moves along in its orbit at a uniform velocity of 13 kilometers per second. This is readily explainable if we assume that the ether in the neighborhood of Jupiter is carried along by Jupiter's gravitational field, and that Jupiter swims in this ether like a fish in the water, but how could we possibly explain such uniform orbital movement in the absence of any ether? If Jupiter obeys Newton's first law of motion, as presumably it must, and if there is no ether, then we could only assume that Jupiter moves along at a uniform velocity relative to the fixed stars. Since however the sun moves along faster than Jupiter, it would be impossible for Jupiter ever to get to the other side of its orbit, unless we make the fantastic assumption that it is speeded up in one half of its orbit and slowed down in the other half. Newton's first law of motion would then have no meaning at all. Obviously the true system of reference in each case is the ether, whose position is

determined by the fixed stars for measuring the velocity of the sun, and by the gravitational field of the central body for measuring the orbital velocity of a planet or satellite.

The photon theory (which should not be confused with the quantum theory) was introduced about half a century ago by Max Planck as a possible interpretation of his radiation formula in an effort to explain the spectrum of black body radiation. Planck's radiation formula is still being interpreted to mean that the radiant energy of light in free space does not spread out uniformly in all directions like sound waves, but remains segregated in separate bundles of "photons". Since the atoms at the time when Planck developed his radiation formula were not considered as having definite structures, it is not surprising that the quantization of energy was attributed to the radiation itself rather than to the atomic oscillators by which such radiation was absorbed or emitted. Today however we know that the atoms are highly organized structures which would be expected to radiate or absorb their energy in quantized amounts, and if such spontaneous quantization of energy is accomplished by the atoms themselves, then the photon theory becomes superfluous.

Since the quantization of energy is a function of the atom and not of the ether, it is not necessary to ascribe to the ether any complicated structure or any strange or mysterious behavior. It can be considered as a simple hydromechanical fluid, devoid of all complications. The existence of an ether is a logical necessity and does not involve any contradictions. Since positive results have been obtained in all experiments where positive results could be expected, there is no justification for all the present-day uncertainty as to its existence.

SUBATOMIC VORTICES

It is sometimes said that any theory which purports to tell us what electricity and the elementary particles of matter really are, stands condemned at the outset. Although it is true that we cannot make something out of nothing, still we do not need to begin with a complex array of protons, electrons and neutrons as our starting point. These subatomic particles and their associated fields of force may themselves consist of selfsustaining forms of motion, such as vortex motion, in a hypothetical ether having only certain general properties, such as inertia and fluidity, but no specific internal structure or molecules with atomic oscillators. Any fluid medium that is capable of supporting wave motion should also be capable of supporting vortex motion, and it would seem inconsistent, after recognizing light as a wave motion in the ether, to refuse to recognize the elementary particles of matter as vortex motion in the same ether. Nevertheless in the modern physics literature the word "vortex" has been about as taboo as the word "ether", and for apparently no reason except emotional prejudice. The physics profession has been inconsistent in maintaining an antagonistic attitude toward some hypotheses while swallowing others whole. It cannot be said that the ether vortex concept is superfluous and of no value. It has not only led to satisfactory explanations for many of the previously unexplained phenomena of physics and chemistry, but it has also provided us with a tangible concept to facilitate our thinking about otherwise abstract subjects.

The distinguishing characteristic of all elementary particles of matter is their *localized persistence of individuality,* and this is also the distinguishing characteristic of vortex motion. Wave motion is not localized like the elementary particles of matter, nor does it have individuality within the full meaning of that term. For instance when a wave is distorted it will not of its own accord revert to its original form but will travel in the directions of the normals to the new wave front, there being no persistence of individuality or memory of the original form of the wave. On the other hand if a vortex ring is distorted from the circular into the elliptical form, it will spontaneously revert into the original circular form. The vortex ring therefore does have persistence of individuality and memory of its original form. Although it is true that a spring or rubber band will spontaneously revert into its original form, nevertheless such spontaneous action of a resilient material body is not an *explanation* of its resiliency but only

an *expression* thereof. The behavior of a resilient material body is merely the combined action of its constituent atoms and molecules and therefore depends on the resiliency of the material of which it is made whereas the resiliency of a vortex ring does not depend on the nature of its material but is an inherent characteristic of the form of the motion itself.

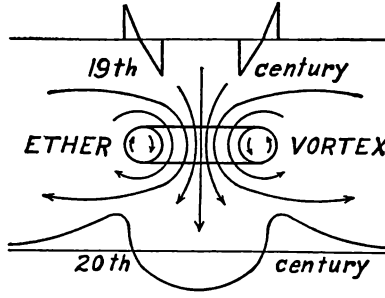

Fig. 1.—An ether vortex ring with its interlinked ether currents. The graphs show the distribution of velocities at different distances from the circular axis of rotation. The presence of such interlinked ether currents distinguishes the 20th century vortex rings from those of the 19th century.

A vortex ring will not only tend to maintain its circular form but will also dynamically and resiliently maintain its dimensions and proportions. There is obviously a lower limit to the possible over-all diameter of the ring because after the opening at the center is completely closed, the ring cannot become any smaller. The inevitable crowding of the ether in the region of this central opening will however prevent any such complete closure of the ring but will tend to expand the ring to a larger over-all diameter. In opposition to this expansive force there are other forces acting in the radially inward direction and tending to compress or contract the ring to a smaller diameter. One of these inwardly acting forces is caused by the impacts of external ether currents against the outer periphery of the ring. Another such force is caused by the centrifugal forces inside the rotating filament. The immediate result of such centrifugal forces will be to make the filament thicker, but since its volume must remain constant, any thickening

of the filament must be accompanied by an equivalent reduction of the over-all ring diameter. The ring will therefore not expand indefinitely but will acquire and maintain definite size and proportions.

Physicists usually try to summarily dismiss the new vortex atom theory with the comment that it is merely a revival of the 19th century theory of Lord Kelvin which proved to be a failure. The broad concept of vortex atoms did not however originate with Kelvin but can be traced at least as far back as 1674 when Nicolas Malebranche stated in his "Recherche de la Vérité" that "la matière subtile ou étherée est necessairement composée de petits turbillons". Since the new vortex theory deals primarily with the vortex structures of the subatomic particles (protons, electrons and neutrons) it obviously cannot be the same as Kelvin's theory because these subatomic particles were not known during the time of Kelvin. These subatomic particles are very specific in their behaviors and must therefore be presumed to have specific structures because it is a universal rule, without any exception, that specific behavior can be explained only on the basis of specific structure. As long as no other type of structure has ever been suggested for these subatomic particles, we must proceed with the assumption that they have vortex structures.

The ether according to Kelvin's theory was not only frictionless but also devoid of any sort of viscidity so that adjacent vortices could have no coordinating effect upon one another whereas in this new theory the vortices are in a viscid but nonfrictional ether similar to that contemplated by Maxwell, Stokes and Fricke. The effect of such viscidity on the distribution of velocities in and around the vortex rings is shown in Fig. 1. In the Kelvin vortex rings the velocity of circulation of the ether would presumably be proportional to the radial distance from the center of rotation but would suddenly drop to zero at the surface of the ring, whereas in the 20th century vortex rings the velocity at the surface of the ring (assuming that it has a definite surface) does not drop suddenly to zero but tapers off gradually in the outward direction. This external circulation is directly involved in all physical and chemical activity, and when it becomes too crowded, the atom bursts to pieces with the liberation of much energy as in the splitting of the uranium atom.

One of the objections which was raised against the 19th century vortex theory was that a vortex ring in a frictionless ether could never be started, but that if it ever did come into existence, then

it could never be destroyed. This would probably be true of the Kelvin vortex rings, but would not be true of vortex rings in the new 20th Century ether or in any fluid which has even a slight degree of viscidity. Any sudden impulse in such a fluid would be

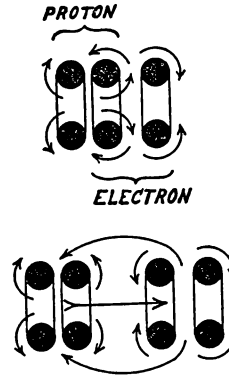

Fig. 2.—The neutron and the hydrogen atom—two electrically neutral particles of atomic weight 1 but with totally different properties. In the hydrogen atom the electron can never fall completely into the proton whereas in the neutron it is already partly within the proton and can be removed therefrom only by its destruction. Hydrogen atoms cannot be transformed into neutrons by any known method, which seems to indicate that they are not merely the same protons and electrons in different states of vibration.

likely to form, at least temporarily, a vortex ring therein. According to A. Betz (1950) such a vortex ring would be produced by the rolling up of a shear surface in the form of a cylindrical sheet.

Another effect of such viscidity is to cause adjacent vortex rings to exert a coordinating effect upon each other so as to bring them into axial alignment and rolling contact whenever possible, which Kelvin's 19th century vortex rings in a nonviscid ether would not do. If we assume that face-to-face rolling contact is a necessary and sufficient condition for structural stability, then with two vortex rings it will be possible to produce two different stable structures as shown in Fig. 2 with the adjacent sides of the two

rings moving either inwardly or outwardly but not in opposite directions. These two structures will also have different external circulations, the one being the reverse but not the equivalent of the other. This immediately suggests a much needed structural basis for protons and electrons and for the electric fields associated therewith.

The problem now is to determine which of these two structures is the proton and which the electron. The proton differs from the electron in having greater mass and therefore more internal energy which means that it is a more stable structure than the electron. The greater mass of the proton cannot be satisfactorily explained by merely assuming that the vortex rings of the proton are larger than those of the electron because we would then have difficulty in drawing a satisfactory picture of the neutron. The cores or filaments of the two vortex rings themselves will undoubtedly contribute some of the mass of the proton, but if the ether has a density of only 0.027 milligram per cubic centimeter, as calculated by O. C. Hilgenberg, then the inertial effect of the ether inside the core or filament would be much too small to account for the actual mass of the proton.

An inspection of Fig. 1 however shows that an ether vortex ring always occupies two regions, namely the rotating inner core of the ring and the surrounding space in which the ether flows in paths that are interlinked with the core, but not necessarily in closed circuits. It may therefore be assumed that the ether which is interlinked with a vortex ring will contribute at least a portion of its mass to the effective mass of the vortex ring. Even this however will not be sufficient to account for the total masses of the protons in any known solid or liquid substance if we assume that the mass of a proton can come only from the intrinsic mass of the entrained ether. The mass of a proton must therefore come almost entirely from some other source, and it may be of gyrostatic origin so as to multiply the intrinsic mass of the ether many times. If the mass of a proton is somehow the result of its internal motion, then it would seem to follow that the mass of the free ether may likewise be the result of the internal motion or turbulence of the latter, and that a perfectly quiescent ether would be without any mass and would therefore be nonexistent.

Of the two dipolar vortices shown in the diagrams, the one in which the polar flow is directed outwardly and the equatorial flow inwardly seems to be the more favorable arrangement for interlinking with external ether currents, and this conclusion is

corroborated by a study of the Magnus effect. If protons and electrons are such dipolar vortices in a turbulent ether, then they will be encountered by the ether currents from all directions as shown in Fig. 3. The horizontally approaching ether currents

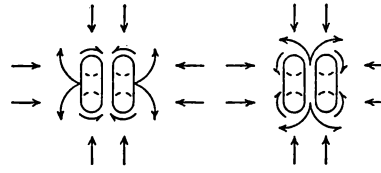

Fig. 3.—The Magnus effect on dipolar vorticles. Since the Magnus effect can exist only in a frictional or viscid medium, it could not occur in the 19th century vortex atoms but should play an important part in the 20th century vortex atoms. Its general effect should be to augment the features of dissimilarity between protons and electrons.

which encounter the dipolar vortex at the left in Fig. 3 will make the rings increase in diameter while the vertically approaching ether currents will make them move more closely toward each other. Exactly the opposite of these two effects will be produced on the dipolar vortex at the right. The effect in each case will be a dilation of the polar sources, a contraction of the polar sinks, a widening of the equatorial sources, and a pinching together of the equatorial sinks. Bearing in mind that a proton has more mass than an electron and is therefore more difficult to destroy, it seems that the structure at the left must be a proton and the structure at the right an electron. The correctness of this choice of structures for protons and electrons is further corroborated by the direction of the magnetooptic effect and by the direction of induced electromotive force, both of which will be dealt with later.

A possible reason why the mass of a proton is greater than that of an electron is that a proton can draw the ether in throughout its entire periphery while an electron can draw it in only at the poles. Since the amount of ether that is sent out is limited by the amount that can be drawn in, the external ether circulation of a proton must therefore be greater than that of an electron, provided we make the reasonable assumption that the sum of the two polar openings is less than the peripheral opening.

Although a positron has the same structural organization as a proton, it has not had sufficient time to acquire any substantial external circulation. The change from a positron to a proton may take only a small fraction of a second, but it cannot be instantaneous. It would first have to pass through the various meson stages before it can develop into a completed proton.

Another factor which should be considered is the Venturi effect. In the proton and also in the electron the externally circulating ether will have to pass through both the peripheral and the polar openings, and if these have different cross-sectional areas, then they will exert a Venturi effect so that the ether which emerges from the poles of a proton will have a higher velocity than that which emerges from the periphery of an electron. Since this externally circulating ether must always remain inter-linked with the proton, it must partake of all the movements of the proton and will therefore contribute its momentum to the proton so as to make the latter more massive than the electron. This is a necessary consequence of the unique structural organizations of these two particles and does not depend on any arbitrary assumption that the proton is smaller in size than the electron.

Although two vortex rings can be arranged with rolling contact in either of two different ways, there is only one arrangement possible with three vortex rings because, as Fig. 2 shows, if the first and second rings are arranged to form a proton then the second and third will form an electron, or *vice versa*. This suggests a structural basis for the neutron which would then be a single elementary particle smaller and more compact than the hydrogen atom, exactly as experimental observations have shown it to be. Since the vortex neutron has opposite electrifications at its two ends, it should be capable of being polarized and should readily attach itself to other atoms, both of which are experimentally established facts. In the vortex neutron the electron and the proton are not separate entities but overlap each other in a unique manner. Such overlapping is possible only with vortex structures and furnishes exactly the kind of structure that is needed to explain not only the compactness and stability of individual neutrons but also the ability of neutron polymers in the form of inert gas atoms to produce positive ions without entering into chemical combinations.

Under the vortex theory such inert gas ionization does not take place by the loss of complete electrons as in chemical ionization but by the shedding of terminal vortex rings from the exposed negative ends of the neutrons. Individual neutrons are so light that when

collisions occur they will rebound rather than disintegrate, but when they are joined to one another as structural parts of an atom then the inertia of the entire atom would have to be overcome before they could rebound, and they would then be more likely to shed the terminal vortex rings from their exposed nega-

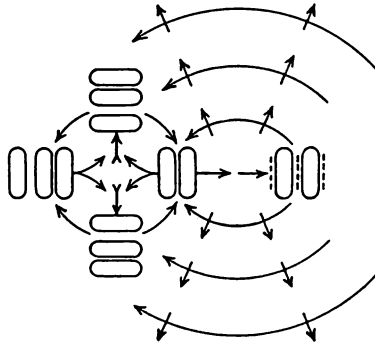

Fig. 4.—An atomic oscillator formed of an ionized helium group with a captured electron. The active portion of such an oscillator has a structure similar to a hydrogen atom, which is itself an atomic oscillator. There are reasons for believing that all atomic oscillators are similar in structure to the hydrogen atom, and this requirement is completely satisfied by the vortex atom. On the other hand in the nucleated atom the electrons are merely pointlike charges of electricity which would have to depend on their environments for their structures, and the different electrons of the nucleated atom are in very different environments. It is inconceivable how a freely floating pointlike charge of electricity could produce any systematic series of spectral lines.

Since the wave length of light is always much greater than atomic dimensions, it was necessary to draw the different parts of the above diagram greatly out of proportion.

tive ends so as to form positive ions. The positive ions thus produced will be of the single proton or unipolar type whereas an ordinary chemical bond under the vortex theory usually comprises a pair of protons arranged as in the hydrogen molecule.

When such a positive unipolar ion becomes associated with a negative electron as shown in Fig. 4 it will form an atomic oscillator having a structure similar to that of the hydrogen atom.

There is still much uncertainty as to the actual mode of operation of these atomic oscillators, but the vortex theory at least furnishes us with a mechanism which should be capable of radiating or absorbing energy at definite frequencies which is more than can be said of the nuclear theory. Pointlike charges of electricity floating freely in space cannot possibly absorb or emit radiation unless they move in definite orbits, and in such latter case they would radiate all the time and at any frequency. On the other hand the vortex atom does have exactly the required mechanism. The vortex rings which make up the protons and electrons under the vortex theory are resilient structures which should themselves be capable of vibrating in various modes and at different frequencies as can sometimes be observed in the case of smoke rings. To account for definite series of spectral lines is not difficult if we have a resilient vibratory structure of this sort to begin with, but nobody has ever offered a satisfactory explanation for spectral lines under the nuclear theory on the basis of freely floating pointlike charges of electricity which are themselves totally devoid of structure.

However important spectral frequencies may be in our study of atomic structure, they are not the only messages that we get from the insides of the atoms as is often erroneously stated. All the phenomena of physics and chemistry are messages from the insides of the atoms, and the innumerable chemical reactions, each unique in one way or another, give us a much greater variety of information about the insides of the atoms than the somewhat restricted information that we get from spectral frequencies. In fact, the very existence of the known chemical elements and the nonexistence of others gives us information about the structures of the atoms which we could never get from a study of spectral frequencies.

In a structure like the neutron shown in Fig. 2, the outward flow from one of the polar sources has to escape equatorially through the overlapping electron which may offer some impediment to such outward flow and thus reduce the effective mass of the neutron as is evidenced by the mass defects of the atoms which consist entirely or mainly of neutrons.

The existence of such a mass defect in the neutron seems to be contradicted by the atomic weight of 1.0089 which the neutron is supposed to have, but we should make allowance for the fact that there is no accurate and direct method available for meas uring the mass of the neutron.

A slight mass defect is also found in deuterium which is to be expected because the two inwardly facing polar sources of the two protons oppose each other. Helium 3 has a mass defect only slightly greater than that of deuterium whereas helium 4 has a much greater mass defect. This is significant in that it seems to show that only the nonionizable neutrons of the helium atom are subject to any appreciable mass defect, and since all neutrons and all protons are alike in their structures, it must be the position and environment of each neutron and proton in the atom which determines its mass defect. This relationship of mass defect to position and environment in the atom, if it could be definitely formulated, should lead to a new quantitative check on the structures of the atoms.

On the other hand we must not lose sight of the fact that the mass defect of helium 3 is approximately the same as that of the deuterium from which the helium 3 was produced. This seems to indicate that the mass defect is not determined primarily by the structure of the atom but that it has been inherited from the precursors of such atom. An inspection of the table of packing fractions will show that there is often considerable difference between the mass defects of the different isotopes of the same element, but nowhere do we find as great a difference as between the two "isotopes" of helium, which seems to show that these are not true isotopes but different chemical elements, of which more will be said later.

The mass defect is measured by the packing fraction (A-W)/W where A is the exact atomic weight and W is the nearest whole number, the values given in the table being 10,000 times this number.

The mass defects of the atoms increase rapidly along the first horizontal row of the periodic table and then remain fairly constant until we get to the neighborhood of tungsten, after which they again diminish until the end of the periodic table is reached. This means that the average mass of each proton or neutron is lowest throughout the middle portion of the periodic table, but increases toward each end. The diminution of mass per proton or neutron is especially rapid along the series of elements from hydrogen to carbon.

PACKING FRACTIONS

	Naturally occurring isotope	Mass number	Exact mass of neutral atom	Packing fraction x 10,000
1	Hydrogen	1	1.00813	+ 81.3
	" (Deuterium)	2	2.01473	+ 73.6
	" (Tritium)	3	3.01704	+ 56.8
2	Helium	3	3.01685	+ 56.2
	"	4	4.00386	+ 9.6
3	Lithium	6	6.01684	+ 28.1
	"	7	7.01814	+ 11.6
4	Beryllium	8	8.00765	+ 9.6
	"	9	0.01484	+ 16.5
5	Boron	10	10.01605	+ 16.0
	"	11	11.01286	+ 14.6
6	Carbon	12	12.00398	+ 3.3
	"	13	13.00766	+ 5.9
7	Nitrogen	14	14.00750	+ 5.4
	"	15	15.00489	+ 3.3
8	Oxygen	16	16.00000	+ 0
	"	17	17.00450	+ 2.6
	"	18	18.0047	+ 2.6
9	Fluorine	19	19.00452	+ 2.4
10	Neon	20	19.99881	— 0.6
	"	21	21.00018	+ 0.1
	"	22	21.99864	— 0.6
11	Sodium	23	22.99680	— 1.4
12	Magnesium	24	23.99189	— 3.4
	"	25	24.99277	— 2.9
	"	26	25.99062	— 3.6
13	Aluminum	27	26.98960	— 3.8
14	Silicon	28	27.98639	— 4.9
	"	29	28.98685	— 4.6
	"	30	29.98294	— 5.7
15	Phosphorus	31	30.98457	— 5.0
16	Sulphur	32	31.98306	— 5.3
	"	33	32.98260	— 5.3
	"	34	33.97974	— 6.0
17	Chlorine	35	34.98107	— 5.4
	"	37	36.97829	— 5.9
18	Argon	36	35.97852	— 6.0
	"	38	37.97544	— 6.5
	"	40	39.97504	— 6.2
	* * *	* *	* * *	
74	Tungsten	180 to 186		0
	* * *	* *	* * *	
92	Uranium	238	238.088	+ 3.7

THE THREE ELEMENTARY FORCES

GRAVITATIONAL FORCE

There are three and only three elementary forces which act at a distance, namely gravitational, electrostatic and magnetic forces. It has been argued by the relativists that gravitation should not be included in the same category with electric and magnetic forces but should be interpreted as a curvature of space rather than as a physical force. Such a metaphysical interpretation does not seem to be required by the observed facts and would only introduce ambiguity and confusion. Gravitation is a physical force because it changes the state of rest or motion of material bodies and therefore requires a physical rather than a metaphysical explanation.

The argument of the relativists that since gravitation cannot be screened it must be something intrinsically different from the other forces of nature is plainly fallacious because the apparent screening of electric and magnetic forces is really neutralization rather than screening. Electric and magnetic forces have polarity and will therefore cause dielectric or magnetic polarization of the material bodies on which they impinge, whereby opposing electric or magnetic forces will be set up so as to counteract the effects of the original forces. The reason why no such effect can be produced by the force of gravitation is because gravitation does not have polarity, and not because it is of more fundamental origin than the other forces.

It has also been suggested that gravitation may be due to a slight preponderance of the attractive over the repulsive forces between the elementary electric charges. The difficulty with such an explanation is that even a small residual effect would still have the same polarization as the original forces and would therefore be subject to neutralization or so-called "screening".

It is meaningless to talk about the force of gravity unless there are at least two material bodies or their equivalents between which the force is considered as acting. As a possible "equivalent" for a material body there may be substituted a beam of light which has mass and energy as evidenced by radiant pressure. However, we are not at present directly concerned with that aspect of the subject and shall therefore confine our attention to two material bodies, preferably of about the same size. There will then be only three theoretical possibilities: They may either attract each other, or repel each other, or have no effect on each other. If the two

bodies were entirely discrete and self-contained they would have no effect upon each other, but it has already been explained that the subatomic particles of which such bodies are composed probably consists of vortices in the ether which keep the surrounding ether in motion. Except in the immediate neighborhood of its origin such motion will be random and disorderly, somewhat like the movements of gas molecules, but the moving portions of the ether will be elongated streamers, threads, or jets rather than pointlike particles. Those streamers which have the highest velocities will move furthest away from the bodies in which they originated and will eventually encounter the streamers from the other body. Since the ether is presumably incompressible, these streamers cannot pierce one another but must be deflected, and the only direction in which such deflection can occur is in the outward radial direction in the common equipotential zone between the two bodies. The flow patterns of the outwardly directed streamers will therefore be different in the region between the two bodies than at their remote sides. In order to compensate for this concentrated outward equatorial flow of the ether in the region between the two bodies there must be an equivalent inward flow which must occur mainly at the remote sides of each body. Two material bodies within each other's field of influence will therefore set up a circulatory system of external ether currents similar to that of the electron, but on a much larger scale. The reverse of this system, which would be similar to that of the proton, can never occur on a large scale because it is only the outwardly directed streamers which will collect in the equipotential zone between the two bodies. The resultant flow of ether will therefore be through each body in the direction of the other, which is probably the cause of the force of gravity, which according to O. C. Hilgenberg would require a downward velocity of about 2074 kilometers per second at the surface of the earth.

If gravitation is an ether-vortex phenomenon as described above, then the ether in the neighborhood of the earth should be carried along by the earth in its orbital movement about the sun, but should not partake of the rotation of the earth about its axis because the gravitational field of the earth is bound to and coordinated with the gravitational field of the sun. All of this is in complete agreement with the Sagnac and the Michelson-Gale experiments. Additional corroboration should be possible with a Foucault pendulum experiment in which the pendulum is kept swinging, not just for a day or two, but for several months. If the

experiment is performed near the north or south pole then the plane in which the pendulum swings should remain coordinated, not relative to the fixed stars, but relative to the sun so as to make about one revolution a year relative to the fixed stars.

The astronomical applications of the ether vortex theory will not be presented in further detail here because there is already an abundance of literature on that subject. See for instance the recent book of E. Ruckhaber (1955).

ELECTROSTATIC FORCE

There is a much closer relationship between electrostatic and magnetic force than between either of these and gravitation. Both electrostatic and magnetic forces are polarized, but they differ from each other in that electric poles are complete in themselves whereas magnetic poles can exist only in pairs, like mirror images.

The distribution of ether currents in the electrostatic field as contemplated by the vortex theory is clearly illustrated by the diagram of the hydrogen atom in Fig. 2. If electrically charged material bodies be substituted for the proton and the electron of the hydrogen atom, then the ether currents which interlink the two charges will still follow the same general course, but on a larger scale. The polar flow will pass along the axial center line from the protons to the electrons while the equatorial flow will be on the outside and in the reverse direction. The effect of such a closed system of circulation in the space between the protons and the electrons will be to reduce the repulsion caused by the viscidity of the ether and thus permit such repulsion from the remote sides to push the protons and the electrons toward each other. There is however a limit to the closeness of their approach to each other because if they would come into actual contact with each other their adjacent surfaces would rub each other in opposite directions so as to cause strong repulsion. This explains why the electrons do not fall completely into the protons. If however two protons are brought very close to each other their original force of repulsion will change over to a force of attraction because the contiguous surfaces will then be moving in the same direction. Such a force of attraction was discovered experimentally in 1936 and has been designated as "supergravitation".

Although protons and electrons are symmetrical bipolar structures, there seems to be no reason why the external ether circulation should have to pass through both poles simultaneously and in equal amounts. Thus when an electron is electrically

coupled with a proton the interlinked ether currents will probably follow the shortest path and remain connected with only those poles which face each other and are nearest to each other.

MAGNETIC FORCE

In the physics literature of today the magnetic field is usually considered as consisting of magnetic lines of force extending circumferentially or spirally around the current-carrying wire, or passing out of the north pole and into the south pole of a magnet. The magnetic line of force itself is usually interpreted as the locus of some medium or agency which causes magnetic action at a distance, and which must therefore be endowed with physical reality. However useful such a concept may be for making practical calculations, nevertheless in the opinion of the writer these magnetic lines of force are merely mathematical fictions, completely devoid of physical reality. If they would have physical reality, then the question would immediately arise as to why their direction is always left-handed and never right-handed relative to the direction of movement of the electrons. Is it possible that the ether in which they must have their abode may be internally twisted, or that the electrons themselves may have asymmetric structures? Such assumptions seem so highly improbable that we feel compelled to look for some other explanation.

The force of magnetism seems to have its origin in the forces of attraction or repulsion between electric currents flowing in the same or in opposite directions respectively. If the electric currents are along circular paths then the magnetic effect will appear in the form of magnetic poles which are either N or S poles depending on the side from which we view the electric currents. It necessarily follows that there can never be a single isolated magnetic pole. All of this is clearly understood in the theoretical physics of today, but the difficulty is in explaining why there will be such attractive or repulsive forces between electric currents.

A simple example of an electric current is the flow of electrons in a copper wire. The ether currents which keep the moving electrons connected with the protons of the copper atoms will then become extended lengthwise of the wire and will keep the moving electrons oriented in the same direction. The polar flow of ether from the protons to the electrons will then be in the direction of movement of the electrons while the external return flow (which constitutes the true magnetic field) will be in the reverse direction in the space around the wire. When the wire

has the form of a solenoid the surrounding ether will therefore circulate in a direction *opposite* to the direction of travel of the electrons and not in the same direction as would be expected under the nuclear theory if the ether were considered as being merely carried along by the moving electrons.

The above conclusion as to the direction of flow of the ether in the magnetic field is a necessary consequence of the vortex structures which have been ascribed to protons and electrons respectively. If these structures would be reversed, then the direction of flow of the ether in the magnetic field would also be reversed. That our choice of structures has been correct seems to be corroborated, not only by the direction of the induced electromotive force in electromagnetic induction, but also by the direction of the magnetooptic effect. All organic substances and nearly all inorganic substances when placed in a magnetic field will rotate the plane of polarization of light in a direction *opposite* to the direction of movement of the electrons in the solenoidal current around the magnet. There are only a few inorganic substances ($FeCl_3$ for example) which are exceptions, and these exceptional cases are probably due to some stroboscopic effect.

The direction of induced electromotive force also leads to the same conclusion as to the direction of flow of the ether in the magnetic field. When a current is started or increased in the primary circuit, the induced current in the secondary will flow in the *opposite* direction which seems to indicate that the free electrons in the secondary are given an impulse in a direction opposite to the direction of movement of the electrons in the primary. Such an impulse can be imparted only by the magnetic field around the primary and seems to consist of a sudden flow of ether in a direction opposite to the direction of movement of the electrons in the primary.

The induced current in the secondary will continue to flow only as long as the acceleration of the electrons continues. After the current in the primary no longer increases in strength there will no longer be any induced electromotive force in the secondary, but the free electrons in the secondary will still be held in their oriented positions by the magnetic field. If the current in the primary then diminishes or stops flowing, the magnetic field will be removed from the secondary and the free electrons which were held in oriented positions by such magnetic field will be released whereupon they will spring back into their natural positions which will constitute a flow of current in the same direction as the current in the primary. Electromagnetic induction therefore leads

to the same conclusions as the magnetooptic effect in regard to the direction of flow of the ether in the magnetic field.

It will be seen from the foregoing that it is the same external flow of ether from the electrons to the protons which forms both the electrostatic and the magnetic field. In the electrostatic field however these external ether currents emerge from and terminate upon electrically charged particles whereas in the magnetic field they flow in closed circuits, either along the path of an electric circuit or around the periphery of a magnet. The reason why an electrostatic charge does not exert any force upon a magnetic pole is because a magnetic pole is electrically neutral. It does not contain an accumulation of one kind of electricity and therefore behaves toward an electric charge in the same manner as any other metal body would behave. Since the ether around an electric charge does not flow in closed circuits but only from the electrons to the protons, any force which this unidirectional flow of ether may exert upon half of the magnetic pole would be counterbalanced by an equal and opposite force upon the other half thereof.

Although an electric charge and a magnetic pole do not exert any force upon each other, they do act upon each other. The electric charge will induce an equal and opposite charge on the adjacent surface of the magnetic pole, while the magnetic pole will induce unidirectional orientation of the electrons relative to the protons in the electrically charged body, just as in any other body which is positioned in a magnetic field. If the body is transparent, then such orientation can be detected by the magnetooptic effect.

Electric and magnetic fields differ from the gravitational field in that the flow of ether in electric and magnetic fields is always confined to limited regions. It either passes from negative to positive charges, or around a closed circuit, whereas in a gravitational field the ether merely passes through any body that is in its path. That is the reason why all efforts to screen or otherwise control the gravitational field have been unsuccessful. If this could ever be accomplished, then interplanetary travel would probably be possible. The problem however is not entirely hopeless. The very fact that the gravitational field acts more effectively upon protons than upon electrons seems to show that gravitational ether currents do coact in some specific manner with electrically charged particles, and if we could only find out the manner in which they coact, then we would be in a better position to solve the problem of interplanetary travel.

THE ORIGIN OF CONSCIOUSNESS

Most of the present day theories concerning the origin of mind and consciousness fall into two main groups depending on whether psychical activity is interpreted as the manifestation of a separate spiritual entity or as the functioning of the brain or central nervous system. The difficulty with the first theory is that the existence of a separate spiritual entity has never been proved experimentally, nor does such a hypothesis offer any clarification. It merely substitutes a greater difficulty for a lesser one. If there does exist a separate spiritual entity then it would have to exist in space because it is inconceivable how an entity could have any other kind of existence. Anything that is real but does not have spatial existence may be an attribute or an aspect, but cannot be an entity. Spiritual entities would therefore also have to be physical entities, and if any such entities existed, then they would have been detected and their presence demonstrated by one method or another long ago.

Belief in a separate spiritual entity, generally referred to as the "soul", is in a large measure due to our innate feeling that we have freedom of the will by virtue of which our choice of action is not necessitated by the forces of nature but is voluntary. We must bear in mind, however, that our will or volition is itself determined by the physical and chemical condition of the brain and central nervous system of which we are not completely and directly aware. "Human liberty of which we all boast" said Spinoza "consists solely in this, that man is conscious of his will but unconscious of the causes by which it is determined." Our will is merely our superficial awareness of the cerebral conditions which induce us to act, but is not itself the cause of our action.

The second theory which interprets psychical activity as a function of the brain or nervous system is however also confronted with difficulties because the brain or nervous system, notwithstanding its complexity, is only a physical or chemical system and would therefore seem incapable of performing anything except physical and chemical functions. Psychical activity does not belong in the same category with physical and chemical activity because psychical activity is not a function at all but an attribute or aspect. It is the subjective aspect of the central nervous system and especially of the cerebral cortex, not in its static but in its dynamic condition.

The cerebral cortex in which consciousness is generally thought to arise contains innumerable synapses which form the complex transitional structures between the sensory and the motor nerves. The individual nerve fibers are porous tubular structures whose walls probably consist of parallel polypeptide spirals joined laterally to one another by cross linking of one sort or another. Such spirals would be of about the same diameter as the benzene ring and if they are composed of optically active amino acid residues they would tend to curl around on themselves so as to form tubular structures of larger diameter such as nerve fibers.

These convolutely wound spiral structures seem to be responsible, not only for the purely biological processes of growth and reproduction, but also for the existence of consciousness and volition because spiral structures of this sort are capable of a more systematic and unified behavior than would be likely to occur in simple lattice formations or other types of structure.

The theory that spiral (or more specifically helical) polypeptides form the elementary structural units of all living matter dates at least as far back as 1927 when the writer published his monograph on "Spiral Molecular Structures, the Basis of Life". The polypeptide helix formed of optically active amino acid residues is exactly the kind of structure that is needed to explain, not only the behavior of nerve fibers, but also life processes generally, such as growth and self-perpetuation. In order to understand the unique characteristics of the polypeptide helix, we must look beyond the purely chemical structures and take into consideration the circulating ether currents that will be associated with these chemical structures. There is an abundance of evidence that molecules act not only by direct contact with other molecules, but that they also exert considerable action at a distance by means of electric and magnetic fields, which are themselves nothing else than vortices in the ether. In the case of polypeptide helices, these tiny ether vortices exert a coordinating effect upon other chemical structures in their neighborhood. A single amino acid molecule will not exert any such an effect, but when a plurality of them are joined to one another, then their combined action will be something very different from the sum of their individual actions. It is not the complexity of the structure, but the simplicity of the structure which makes such combined action possible.

The individual nerve fibers contain not only nutrient materials capable of being oxidized with the liberation of energy, but also a high concentration of potassium ions whereas the surrounding

regions outside the nerve fibers are relatively low in their potassium content but high in their sodium content. Recent investigations seem to indicate that this separation of the potassium ions from the sodium ions is maintained in some unknown manner by selective diffusion through the walls of the nerve fibers and that it has the effect of keeping the inside of the nerve fiber negatively charged and its outside positively charged. When a nerve fiber is at rest the porosity of its proteinaceous outer wall is just sufficient to maintain this electrical double layer by some such selective diffusion of ions, but if the fiber is disturbed or irritated its porosity will be increased at the point of irritation and a wave of increased porosity will travel along the fiber. The potassium ions will then migrate outwardly and the sodium ions inwardly through this region of increased porosity so as to momentarily eliminate the electrical double layer. Nerve fibers formed of convolutely wound polypeptide spirals are ideally suitable for selective diffusion processes of this sort because adjacent convolutions of such spirals may then be loosely connected to one another at regular intervals through hydrogen bonds between the amino and the carbonyl groups.

In the synapses of the cerebral cortex the outer regions of positive electrification around adjacent nerve endings will merge into one another to a limited extent so as to form association channels of varying resistance for transmitting nerve impulses from one region to another. The pattern of action will be determined by the chemical structures of the synapses, but the impulses themselves will be electrical in character and will be transmitted directly through currents or vortices in the ether which will merge into one another in the region of the synapses and thus form a unified electrical system to serve as a physical basis for unity of consciousness.

The cerebral cortex is also characterized by the extreme complexity of the proteinaceous chemical structures of the synapses which contain all the memory records of sensory impulses. The complexity of the cortex must be at least as great as the complexity of consciousness itself because although consciousness probably has its origin in the sentiencies of the subatomic particles, it owes its complex pattern of action to the structural complexity of the cortex. The actual complexity of the cortex is really much greater than the complexity of our consciousness because our consciousness must always be within the limits of our comprehension whereas the cerebral cortex is almost inconceivably complex in its histological

structure alone, and its chemical complexity is thousands of times greater than its histological complexity.

The feelings of an animal organism are complex not only in their intrinsic nature but also in their spatial distribution. Although the intrinsic nature of our sensations is determined by the conditions in the cerebral cortex, the sensations themselves may be in remote parts of the body, but only in those parts which are reached by our sensory nerves. Inert structures may be integral parts of the body but are not in functional unification with the central nervous system. Such functional unification can consist only of direct electrical interlinking of the different parts of the nervous system by circulating ether currents through which electrical impulses can be transmitted from one region to another.

Consciousness involves not only the electrochemical pulsations passing along the nerve fibers and synapses but also indirectly the activities of the atoms and subatomic particles that are associated with such pulsations. If these subatomic particles are vortices in the ether, then we have here an adequate mechanistic basis for mind and consciousness. Since ether vortices are unified in their physical characteristics, they should also be considered as having unified sentiencies or psychical characteristics because if it is the physical unification of the central nervous system that causes the latter to have consciousness, then it is reasonable to assume that there will be consciousness of one sort or another wherever there is physical unification.

Spontaneity of action and voluntary exercise of the will, which usually characterize physical activity, are also characteristic features of vortex motion. For instance a vortex ring which has been distorted from the circular into the elliptical form will spontaneously revert into its original circular form, not because of any inherent resiliency of the material of which it is made, but as an inherent characteristic of vortex motion itself. All spontaneous activity can be traced, directly or indirectly, to the activities of the individual vortices which make up the subatomic particles. Mind and matter merge into each other and lose their separate identities at their subatomic scource and origin.

Our consciousness is not always neutral in its attitude toward different sensations but may comprise feelings of pleasure or pain. It seems to be our general experience that the free pursuit of one's inclinations is accompanied by pleasure whereas the restraint of such free pursuits is accompanied by unpleasantness which belongs in the same category with pain. Stated in a more general

way, it means that pleasure accompanies spontaneous activity with the conversion of potential into kinetic energy whereas unpleasantness or pain accompanies restraints imposed from without and the building up of potential energy within. Spontaneous changes with increase of entropy are therefore accompanied by pleasure whereas forced changes with decrease of entropy are accompanied by unpleasantness or pain.

Since spontaneous activity in the world about us is always in the direction of more pleasure and less pain, we may reasonably suspect that the elementary particles of matter are similarly hedonistic in their individual activities. Thus the absorption of radiant energy by an atom should be accompanied by some rudimentary form of displeasure because the absorbed radiation is forced upon the atom from without and increases its potential energy whereas the emission of radiant energy should be pleasureful to the atom because it is a spontaneous activity with diminution of potential energy and with increase of entropy. For similar reasons oxidation processes and other exothermic chemical reactions should be pleasureful whereas the decomposition of compounds with the endothermic severance of valence bonds should be painful. The general rule seems to be that any forced alteration which a stronger system makes upon a weaker system is unpleasant to the weaker system.

Nature is also hedonistic in that any group of particles when left entirely to itself will of its own accord pursue the course of maximum pleasure. For instance if two particles carry like electric charges they will recede from each other so as to convert their potential energy into kinetic energy, whereas if they carry unlike charges they will approach each other with a similar conversion of potential into kinetic energy. The tendency in nature is always to move away from what is painful and toward what is pleasureful.

THE NEW VORTEX ATOMS

According to the new vortex theory the atoms of the various chemical elements are not nucleated but centrally connected radial structures which are usually formed mainly of helium groups but may also carry one or more valence bonds in the form of terminal hydrogen groups similar to hydrogen molecules. Different isotopes of the same element can be formed by bringing larger or smaller numbers of vortex rings into juxtaposition to form the individual subatomic particles. As long as the vortex rings are added or removed two at a time the state of electrification of the subatomic particle will not be changed and the external peripheral structure of the atom will remain substantially the same as it was before. All isotopes of the same element will therefore have substantially the same physical and chemical properties, but may differ in their radioactivity.

In most of the figures the circulating ether currents have been omitted and only the central structural portions have been shown, but in Fig. 10 there is presented a complete picture of an atom, including the space occupied by the circulating ether currents. The atom shown in Fig. 10 looks quite similar to some of the modern versions of the nucleated atom but is very different from the original Rutherford-Bohr atom, nor does it bear any resemblance to the Kelvin vortex atom. It is however partly anticipated by the atom of Philipp Lenard (1903) if the different helium groups be regarded as the dynamids of the Lenard atom. It is also partly anticipated by the atom of Johannes Stark (1915) in which the valance bond consisted of a pair of negative electrons in close association with a pair of protons in the adjacent periphery of the adjoining atom, but apparently Stark failed to realize that his two protons would themselves have to be carried by a structure similar to the neutron which is capable of swivelling so as to permit free rotation at the valance bond as in carbon compounds.

In all vortex atoms (except hydrogen) all parts are *firmly bound* to one or two central helium groups so that the entire atom will rebound if this central region is struck by a high velocity particle. There is no experimental evidence that the entire mass of an atom is *contained within* this tiny central region in the form of an atomic nucleus instead of being just firmly bound thereto as in the vortex atom. Although the deflection of high velocity particles is explained about equally well by the nuclear and the vortex

theory, the latter has the advantage of being practically free from contradictory assumptions and arbitrary postulates as for example point charges of electricity that oscillate but do not radiate and planetary electrons that move in orbits around the atoms but at

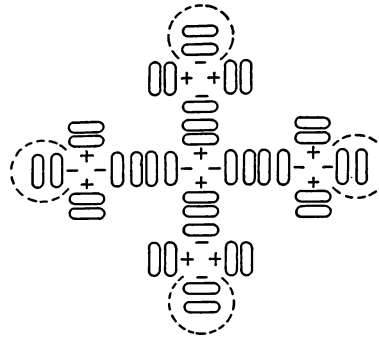

Fig. 5.—The carbon atom. In this and many of the other atoms the number of electrons is not equal to the number of protons, but there is no reason why they should always have to be equal in number to produce electrically neutral structures. Electrification is a surface phenomenon and we have no proof that the usual principles of electrostatics are applicable inside the atoms. In fact, the proton-proton and proton-neutron attractions at close ranges are evidence to the contrary.

the same time remain in fixed positions between adjacent atoms to hold them in chemical combination. Many clever attempts have been made by nuclear physicists to overcome these difficulties by skillful verbal maneuvers, but they have not been convincing. We still do not have any intelligible picture or diagram of the nucleated atom or any operative model thereof, and with such a melee of interacting and interfering orbits and forces as would necessarily have to be present in the Rutherford-Bohr atom, it will forever remain impossible to form a clear concept of the same. Atoms so constituted could not exist in nature because it would require superhuman intelligence to keep the planetary electrons and their interacting forces in systematic and orderly cooperation whereas there is every reason to believe that the atoms are merely products of nature and that they are not under any intelli-

gent control at all. Difficulties of this sort do not exist in the new vortex atom which is essentially nothing more than a cluster of helium groups, either with or without peripheral hydrogen groups. In such an atom the predominating forces are merely the

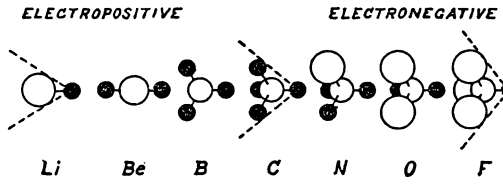

Fig. 6.—The atomic structures of the first horizontal row of the periodic table. Each circle represents a helium group while each large black spot represents a hydrogen group or valence bond. The dotted angles indicate the gradual transition from electropositiveness to electronegativeness. The valance bonds are more exposed in the metals than in the nonmetals. The metals will therefore more readily lose their valence electrons than the nonmetals. Under the nuclear theory we are supposed to believe that the atoms become more hungry for negative electrons as more of them are crowded into the outer shells.

local bonding forces of the helium and hydrogen groups which present no insuperable difficulties to the understanding.

The adoption of this new vortex atom theory would not require the sacrifice of anything of value from the theories of modern physics. Modern quantum mechanics could be retained in its entirety with only a few slight changes of nomenclature, some of which have already been made as for example the substitution of *electron configurations* for "electron orbits". The equation $E = Mc^2$ expressing energy in terms of mass (first published by Hasenöhrl in 1904 and a year later by Einstein in 1905) is as applicable to the vortex atom as to any other form of atom. The representation of the atoms as centralized structures with their negative electrons on the peripheral portions thereof would remain as correct under the vortex theory as under the nuclear theory.

The Rutherford-Bohr model of the atom would have to be definitely discarded, but it seems that physicists have already practically discarded it as a result of their own experimental investigations. Although they are still paying verbal tribute to the term "atomic nucleus", they are no longer interpreting the nucleus as a tiny pointlike kernel at the center of the atom but rather

as an open porous structure with different energy levels extending far out into the peripheral portions of the atom. If we ignore the mere use of the word "nucleus", then the actual atomic structures that are dealt with in the physics literature of today bear a closer resemblance to the new vortex atom than to the original nucleated atom of Rutherford and Bohr.

Nevertheless the exponents of the nuclear theory have been trying to discredit this new vortex theory with the remark that it has not yet reached the quantitative stage. That may be true, but the nuclear theory, although much older than the vortex theory, has not yet given us even a satisfactory *qualitative* explanation for most of the phenomena mentioned in this book. Neither does the nuclear theory have any exclusive monopoly over quantitative explanations which are usually mathematical in

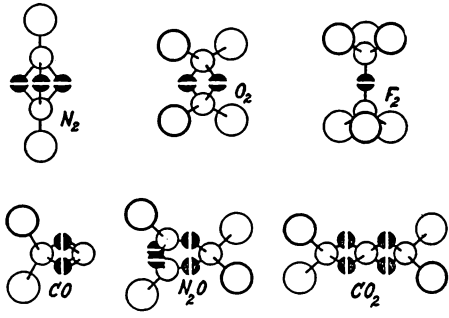

Fig. 7.—Molecules of familiar gases. Each circle represents a helium group and each black spot a hydrogen group in the form of a valence bond. Nitrogen is inert because of the structural stability of the nitrogen molecule in which the valence bonds are concentrated near the center and the helium groups of the two atoms do not oppose each other but ward off interference from the outside. Oxygen is chemically active because the helium groups of the two atoms oppose each other so as to counteract the efforts of the valence bonds to hold the two atoms together. Fluorine is similarly active because of the crowding of the helium groups. Those gases whose molecules have the same number of helium groups similarly arranged also have similar physical properties. The reason why there is no stable fluoride of oxygen is because the molecule would have eight peripheral helium groups, which are too many for so small a molecule. The oxygen difluoride molecule would also be unsymmetrical because of the tetrahedral form of the oxygen atom.

character and do not depend on any specific physical concept of the atom. Whatever quantitative relationships can be shown to exist under the nuclear theory would be equally true and valid under the vortex theory, provided of course that the necessary changes of nomenclature be made. Another remark has been that this new vortex theory is not truly scientific because it is not mathematical. It does however permit the atoms to be represented geometrically, and geometry is a branch of mathematics.

The diagrams show that the atoms of the various chemical elements differ from one another in the number of peripheral hydrogen and helium groups, which seems to account for the difference in their melting points. Hydrogen groups being valence bonds, those elements which have the greatest abundance of hydrogen groups and the fewest helium groups should melt with greatest difficulty. Carbon being the only element (except hydrogen) which does not have any peripheral or exposed helium groups, it is also the most refractory of all elements. The transition from the solid to the gaseous state as we pass from carbon to nitrogen is due to the formation of diatomic molecules in which the valence bonds are between the two atoms in somewhat protected positions and chemically connected to each other. This relationship of melting points to peripheral hydrogen and helium groups holds true almost quantitatively among all the simpler elements, but among the heavier elements it is disturbed and sometimes quite obliterated by other complications such as the rotational displacement of one peripheral group relative to another and by the formation of internal chemical bonds between different hydrogen groups of the same atom.

The inertness and stability of the nitrogen molecule is due to its peculiar architecture with the valence bonds forming a pair of rigid tripods near the center of the molecule, which are protected against attack from the outside by helium groups at their apexes. The oxygen molecule is not as stable as the nitrogen molecule and is chemicaly more active because in the oxygen molecule the peripheral helium groups of the two atoms are positioned in such a manner that they will continually collide with each other in opposition to the efforts of the valence bonds to hold the two atoms together. The fluorine molecule, although containing two more helium groups than the oxygen molecule, is nevertheless stable enough to exist as a diatomic molecule. It probably owes its stability to the single valence bond which permits free rotation of the two atoms so that the three peripheral helium groups of the one

atom can assume staggered positions relative to those of the other atom. Although there are several oxides of nitrogen, there is no stable fluoride of oxygen. A molecule of oxygen difluoride would have eight peripheral helium groups which is too many for so small a molecule, and besides the molecule would be unsymmetrical because of the tetrahedral form of the oxygen atom.

As indicated in the table, there is a close similarity in the physical properties of nitrogen and carbon monoxide, and also in the physical properties of nitrous oxide and carbon dioxide. Similarity of physical properties can be explained only on the basis of similarity of the peripheral structures of the molecules, but the peripheral electronic configurations of the N_2 and CO molecules are by no means similar under the nuclear theory where the N_2 molecule consists of two identical halves while in the CO molecule the corresponding halves are far from being identical. On the other hand the N_2 and CO molecules as pictured by the vortex theory are almost identical in their peripheral structures in that each of them carries two peripheral helium groups at diametrically opposite points.

The peripheral electronic configurations of the N_2O and CO_2 molecules are also completely different under the nuclear theory but are almost identical under the vortex theory. The N_2O molecule is a cyclic structure whereas the CO_2 molecule is a straight

GASES WITH SIMILARLY SHAPED MOLECULES

	N_2	CO	N_2O	CO_2
Critical temperature	—127°	—122°	35.4°	31.9°
Critical pressure (atmospheres)	33	35	75	77
Density of liquid	0.796	0.793	0.856	0.858
Viscosity	166 x 10-6	163 x 10-6	148 x 10-6	148 x 10-6
Magnetic susceptibility			0.12 x 10-6	0.12 x 10-6
Formula of hydrate			$N_2O.6H_2O$	$CO_2.6H_2O$
Heat of formation of hydrate			14,900	15,000

chain structure and since each atom must be assumed to carry its own shell of electrons, there obviously cannot be any similarity between these two molecules under the nuclear theory. Under the vortex theory however they have almost identical peripheral structures in that each of them carries four peripheral helium groups in tetrahedral arrangement.

In the above discussion we have referred only to the peripheral or outermost helium groups of the vortex molecules, because physical properties depend more on the peripheral structures than on the internal structures of the molecules. However, the explanation under the vortex theory will not break down, even if we extend our scrutiny to the interiors of these molecules. In addition to the above mentioned peripheral helium groups, the N_2 and CO vortex molecules each have also two helium groups in their interiors, while the N_2O and CO_2 vortex molecules each have also three helium groups in their interiors. No such structural similarities exist in the corresponding nucleated molecules.

As will be apparent from the diagrams, the tetrahedral form which is so characteristic of the carbon atom is also exhibited by the trivalent nitrogen atom, which accounts for the *cis* and *trans* isomerism of oximes and diazo compounds. Similar tetrahedral forms are also exhibited by the divalent oxygen, sulfur and selenium atoms. No explanation for the tetrahedral forms of these trivalent and divalent atoms has ever been offered under the nuclear theory.

Recent experiments with microwave spectroscopy have shown that the nitrogen atom as well as the carbon atom is capable of buckling from one enantiomorphic form into the other without any severance of the valence bonds. Such buckling probably occurs in the asymmetric carbon atoms of optically active compounds during racemization by heat, and also in some of the carbon and nitrogen atoms of colored compounds. Such colored compounds usually have at least one double bond linking together major portions of the molecule. Although there cannot be any free rotation at a double bond, nevertheless there may be a partial rotation due to buckling as a result of which the molecule will be able to assume either of two stable configurations which will not be mirror images of each other as in the case of optical enantiomorphs but will be different physical structures with different heats of formation so that they will have a tendency to absorb radiant energy while in one configuration and liberate it at a different frequency while in another configuration.

Since the valence bond of the new vortex atom is constituted like a hydrogen molecule, it will have the same structure in all atoms whether light or heavy, which explains why the ability of two atoms to combine chemically with each other is not restricted to atoms of approximately the same size and weight. If the valence electrons moved in orbits about the atoms as taught by the nuclear theory, then it would be difficult for large and small orbits to become definitely coordinated with each other so as to form valence bonds unless the orbits were easily deformable, and in the latter case it would seem impossible to explain the rigidity of crystals.

Nearly all substances in the solid state and at low temperatures have glasslike rigidity, from which it necessarily follows that the individual atoms and molecules must have equally high degrees of rigidity. This great atomic rigidity offers no particular difficulty to the vortex theory because skeletal structures formed of vortex rings would be expected to have considerable rigidity, but how any condition of glasslike rigidity could possibly exist in the nu-

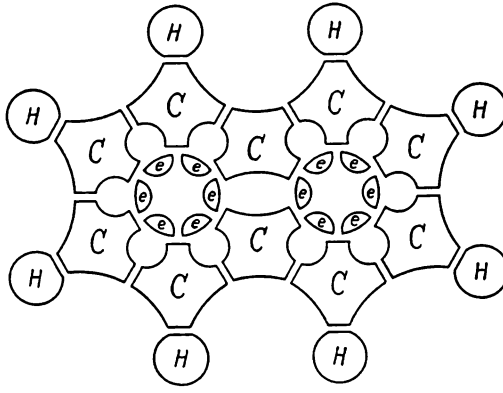

Fig. 8.—The naphthalene molecule with its two inner rings formed of valence electrons e connecting adjacent carbon atoms with one another. The benzene molecule would be an obvious simplification of this structure. The ability of an electron to divide its charge between two adjacent carbon atoms and also the ability of two such electrons to be joined to a single valence bond is demonstrated by the covalent bonds of carbon compounds.

cleated atom with its widely scattered electrons (not to mention the wave atom) is beyond the understanding.

The two protons in the vortex atom valence bond offer two points of attachment which makes such a valence bond more versatile than the simple electron valence bond of the nuclear theory. This dichotomous structure of the vortex atom valence bond permits the joining of three or four bonds directly to one another so as to form branched valence bonds which are usually of the Y type, but may occasionally be of the X type, depending on whether the junction is between three bonds or between four bonds. This explains not only the multiple valences of some of the elements but also leads to a solution of the benzene ring problem.

In the textbooks of organic chemistry the benzene ring is usually represented as a conjugated system of single and double bonds in accordance with the Kekulé formula, supplemented with the remark that the bonds are in a state of resonant tautomerism so as to permit the formation of only one ortho-substitution product. It seems however that valence electrons which jump around freely from one atom to another would render the molecule very reactive chemically, which would not explain the stability and chemical inertness of the benzene ring. Before there can be resonance of any sort, there must first be a stable molecular structure, and if we do have a structure with the requisite stability, then the resonance concept becomes superfluous. If such resonance does occur, then it can only be the result and not the cause of molecular stability. The resonance theory therefore cannot be considered as the solution of the benzene ring problem.

The incorrectness of the Kekulé structure is illustrated especially in the formation of addition products. The first addition product always forms with difficulty and usually by an endothermic reaction whereas the subsequent addition products are formed more readily and by exothermic reactions. This behavior is exactly the opposite of what it should be under the nuclear theory with the Kekulé structure because a molecule which is already partly saturated should take on substituents less vigorously and not more vigorously than a completely unsaturated molecule.

Various other structures have been proposed for the benzene ring but they have never become generally accepted and will therefore not be considered here. The only fair conclusion that can be drawn is that the benzene ring structure has heretofore remained an unsolved problem. All the difficulties associated with the benzene ring structure do however seem to be avoided by the use of

the branched valence bonds of the new vortex atom which will provide the benzene or other aromatic molecule with a rigid interior framework having a closed inner ring structure, as in the case of the naphthalene molecule shown in Fig. 8. The first addition reaction will then take place with difficulty because there must first occur a breaking of this inner ring structure, but after that has occurred the subsequent addition reactions will take place more readily because the partly saturated benzene ring will no longer have this stable inner ring structure but only ordinary double bonds like those of olefines and quinones.

It is interesting to observe that although these new atomic structures were arrived at on the basis of the ether vortex theory, they could just as well have been arrived at on the basis of experimentally known facts, independently of any theory. Thus it is known from direct experimental evidence that the neutron is polarized, and that its mass is concentrated at the end which is positively charged. It may therefore be considered as a close union of an electron and a proton and may be represented by the symbol $+[\ ]-$ without making any assumption as to what is inside the brackets. By analogy to the hydrogen molecule it may then be assumed that four of these neutrons can form a radial cluster with two positive charges in close proximity to two negative charges at the center. Since each of these neutrons is electrically neutral, the cluster thus formed will also be electrically neutral and will obviously be the neutral helium atom. Since this cluster carries on its periphery two negative charges which can be nothing else than electrons, it can be substituted for one of the electrons of the hydrogen molecule so as to form a structure that would have all the properties of the lithium atom. By proceeding in this manner we could build up the atomic structures of all the other elements without bringing in the ether vortex concept at all.

RADIOACTIVITY AND ATOMIC FISSION

Since hydrogen has atomic number 1 and helium atomic number 2, it seems that the atomic number of any element should be equal to the number of hydrogen groups plus twice the number of helium groups which make up the atoms of such element. The inert gas atoms can then be accounted for by the structural scheme shown in Fig. 9.

The original experimental basis for the atomic number system consisted of Moseley's measurements of X-ray diffraction spectra which exhibit a regular and progressive displacement in the direction of the shorter wave lengths as the atomic numbers increase, without any of the periodicity which is characteristic of physical

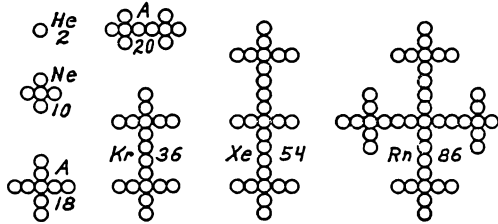

Fig. 9.—Inert gas atoms. The structural scheme shown in these diagrams will account for the atomic numbers of these atoms, except for a possible irregularity in the case of argon.

Neon consists mainly of an isotope of atomic weight 20, which is exactly half of the atomic weight 40 of the predominant isotope of argon. This suggests that argon may consist, at least in part, of a polymer of two neon atoms. The atomic number of such a polymer would be 20 instead of 18 if we assume that each helium group contributes 2 to the atomic number. It is not likely, however, that argon actually exists in both of these forms because argon 20 would be less stable than argon 18 because of greater crowding of the helium groups. Furthermore the existence of two forms of argon is not corroborated by spectroscopic evidence.

A complete series of inert gas atoms should also include the neutron and the so-called "lower isotope" of helium, namely He^3. The fact that neutrons will readily attach themselves to other atoms does not make them any the less chemically inert. They are probably the building blocks of all other inert gas atoms.

The structures shown in these diagrams should be visualized as occupying three dimensions of space.

and chemical properties generally. Since these X-ray spectra are obtained by reflection from the internal structures of the atoms, such internal structures must be under tension. According to the nuclear theory such tension would have to be of the electrostatic variety, but that does not offer much clarification in the absence of any explanation for electrostatic force itself. The new vortex atom however has an internal structure as shown in Fig. 10 whose radial tension would depend primarily on the total number of hydrogen and helium groups of which the atom is composed. Such radial tension would therefore increase regularly with the atomic number, without any periodicity.

The distance to which the circulating ether currents reach out radially beyond the inner skeletal framework of an atom can be calculated, at least approximately. If the atomic radii of the

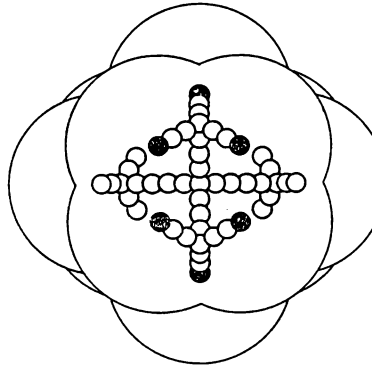

Fig. 10.—The uranium atom with its circulating ether currents which constitute the outer portion and the greater part of the volume of the atom. Since these ether currents are crowded together against their tendency to expand they are under compression whereas the inner skeletal framework of the atom is under tension. Ordinarily the tensile strength of the skeletal framework is greater than the expansive force of the surrounding ether currents, but if the reverse condition is established then atomic fission will occur. Much energy will then be liberated because the expansive forces of the circulating ether currents will continue to act over considerable radial distances whereas the cohesion in the skeletal framework will be broken almost instantaneously.

various chemical elements be calculated from the densities of the elementary substances in the solid state, then it will be found that the largest atoms have radii only about 1.5 times the radii of the smallest atoms. On the other hand the inner skeletal structures of the largest atoms are about 10 times as large as those of the smallest atoms. If we assume that the radial distance x throughout which each helium group keeps the surrounding ether in circulation is always the same regardless of whether the atom is light or heavy, then the value of x in terms of r, the actual radius of a helium group, can be determined by solving the equation

$$1.5\ (r + x) = 10r + x$$

which gives

$$x = 17r.$$

The circulating ether currents may therefore actually reach out somewhat further than is indicated on Fig. 11.

The foregoing interpretation of atomic numbers is also in agreement with the radioactive displacement law. When an alpha particle with two positive charges leaves an atom it reduces the atomic number by two, whereas the emission of a beta particle with one negative charge increases the atomic number by one. Stated in another way, it means that the internal tension of an atom would be increased as much by the *addition* of one proton and one neutron as by the *removal* of one electron. Since a transition from one isotope to another has no effect on the atomic number, the addition of the neutron may be disregarded and the proposition further simplified by stating that the addition of one proton to an atom increases its internal tension as much as the removal of one electron. It is not difficult to understand why the addition of a proton with its external ether circulation would increase the internal tension of an atom, but it is not so clear why the removal of an electron would have the same effect. The simple removal of an already existing electron would probably not have this effect, but the situation is different if the beta particle is formed *de novo* at the instant of emission. Since a beta particle consists of two vortex rings, it may be formed synthetically by the simultaneous ionization of two closely adjacent neutrons which would thereby be converted into protons. Let us assume for instance that two neutrons are loosely attached to the free outer negative end of a helium group. While they are in this condition they would increase the atomic weight but not the atomic number or the internal tension of the atom because a neutron, being electrically neutral, does not have the same external ether circulation as a

proton. When however two such closely adjacent neutrons undergo simultaneous ionization, the two liberated vortex rings may combine with each other to form a beta particle while the erstwhile neutrons would be converted into protons so as to form an ionized hydrogen group. The external ether circulation which would be produced by these two protons would increase the internal tension of the atom, and the presence of the additional hydrogen group would increase the atomic number by one. The reason why it would increase the atomic number by only one and not by two is because the two protons would have only one unit of exposed positive charge, half of the charge of each proton being neutralized by the electron on the free end of the helium group to which the two protons are attached.

The emission of alpha particles may be explained not only by the separation of complete helium groups but also by the formation of such particles *de novo* at the instant of emission. For instance an alpha particle may result from the union of either four neutrons or two neutrons and two protons. These may come not only from helium groups but also from hydrogen groups. In the latter case the protons of the hydrogen groups may have been substituted by or transformed into neutrons. Since an alpha particle could be formed from either one helium group or from two hydrogen groups, it necessarily follows that one helium group contributes as much to the atomic number and internal tension of the atom as two hydrogen groups.

Radioactive transformations are too numerous to take up in detail here, but a few typical examples will be considered in order to show that radioactivity offers no particular difficulties to the vortex atom theory. Modern alchemy began in 1919 when Rutherford subjected dry air to bombardment by alpha particles and observed on a zinc sulphide screen some feeble scintillations which could only have been high velocity protons produced by a transmutation which is usually written as follows:

$$_2He^4 + {}_7N^{14} \rightarrow {}_8O^{17} + {}_1H^1.$$

The high velocity proton $_1H^1$ could only have come from a hydrogen group of the nitrogen atom when such hydrogen group was struck by the alpha particle $_2He^4$ and displaced by the latter. After such a collision the resulting atom would have only two remaining hydrogen groups but would have one more peripheral helium group so as to have all the characteristic features of an oxygen atom.

Another transmutation of historical importance is the conversion of boron into nitrogen which is usually written as follows:

$$_5B^{10} + {}_2He^4 \longrightarrow {}_7N^{13} + {}_0n^1.$$

The neutron n that was set free by this collision evidently came from the central helium group of the boron atom which has one exposed neutron, very close to the center of the atom. When the alpha particle collided with and knocked out that neutron its place was evidently taken by the alpha particle so that the resulting atom, although still having the same three hydrogen groups that it had before, would have added to it one peripheral helium group. It would therefore have all the characteristic structural features of the nitrogen atom, but would be a lower isotope of nitrogen with an atomic weight of only 13. Such a lower isotope of nitrogen is radioactive. It expels a positron and becomes ${}_6C^{13}$, a higher isotope of carbon, which is stable and occurs in nature. This last-mentioned transmutation is probably caused by the new peripheral helium group being under too much strain, as a result of being too close to the center of the atom. The neutrons on the two sides of this helium group are probably pushed further away from the center of the atom while the single neutron at the free end of this helium group has dropped down into axial juxtaposition with the neutron at the inner end of this helium group. At the same time the two lateral neutrons, during their outward displacement, have probably collided with each other in such manner as to form a position (namely a nascent proton) *de novo* from the vortex rings at their negative terminals so as to leave remaining only two protons which will form an additional hydrogen group. The atom thus remodeled will therefore have a total of four hydrogen groups and will be an isotope of carbon.

In a similar manner we could go on almost indefinitely accounting for the various radioactive transformations on the basis of the vortex atom theory, but without elaborate diagrammatic illustrations it would be difficult to convey a clear understanding of what actually happens, and the examples given hereinabove should be sufficient to convince the reader that radioactivity can be explained as readily by the vortex theory as by the nuclear theory.

There is however one remaining subject that should be mentioned, and that is the time delay in radioactive changes. Each radioactive atom will remain perfectly stable until its destined time arrives, and then for apparently no reason it suddenly explodes. The reason

cannot be that it was struck by a cosmic ray particle because if that were the cause of radioactivity, then there would have to be a much greater abundance of cosmic ray particles than have actually been detected. The radioactive atom must itself have undergone some internal change, and since radioactivity occurs not only in the heavier elements but also in elements as light as hydrogen, (namely in tritium,) such a change must be in the individual vortex rings themselves. It cannot be merely a change in the shapes and proportions of the vortex rings because their shapes and proportions are maintained in continual adjustment to their environments whereas radioactivity is almost completely independent of the environment. It is only the volume of a vortex ring, namely the amount of ether that is entrapped in the rotating core or filament, which may gradually increase or decrease.

If such a change of filament volume does occur, then we would expect it to depend not only on where the vortex ring is positioned in the atom, but also on what its volume was at the time when that particular atom was formed from other atoms or subatomic particles. The atoms which are in the world now have been in existence for only limited periods of time. They were formed from other atoms or subatomic particles, either by a building up or by a breaking down process, and every time when there is a transmutation from one atom into another, the vortex rings which make up such atom will experience a change of environment *inside the atom.* Although the external environment has no effect on radioactivity, the immediate environment inside the atom may be capable of exerting such an effect.

We are, however, still confronted with the question of why the atoms of any particular radioactive isotope do not all take exactly the same amount of time to disintegrate. One possible explanation is that the vortex rings which occupy similar positions in different atoms of the same isotope were probably not all of exactly the same size at the time when these atoms were originally formed. Another possible explanation is that the building up and breaking down of atoms has probably been occurring continually during all past time, so that it could hardly be expected that the atoms of any particular isotope that is now in existence are all of exactly the same age. If some of these atoms are older than others, then the older ones may be expected to disintegrate sooner than the younger ones.

THE NUCLEAR THEORY DISPROVED

The many successful applications of the new vortex atom theory in the fields of physics and chemistry seem so convincing that no further disproof of the nuclear theory should be necessary, but since the nuclear theory is deeply embedded in scientific literature, it will require more than mere argument to dislodge it. The recently discovered anomalous properties of He^3, the so-called "lower isotope" of helium, are however so conclusive against the nuclear theory that there no longer seems to be any room for doubt. He^3 differs from ordinary helium (He^4) in the following respects:

(1) It does not exhibit any superfluidity;

(2) It has a definite and measurable magnetic moment whereas He^4 has none;

(3) It has a vapor pressure many times that of He^4, and a much lower boiling point;

(4) It has a very different spectrum;

(5) In the liquid state it has a density only slightly more than half that of He^4, and not equal to three-fourths thereof as it should have under the nuclear theory;

(6) It does not dissolve in superfluid He^4 (namely helium II) whereas isotopes of the same element are always soluble in each other.

Efforts have been made to account for the difference in properties of He^3 and He^4 on the theory that the atoms of the former are composed of an odd number of elementary particles (protons, electrons and neutrons) and therefore behave in accordance with Fermi-Dirac statistics whereas the atoms of the latter are composed of an even number of elementary particles and therefore behave in accordance with Bose-Einstein statistics. The difference between these two statistical states is that in the former there still remains considerable residual motion after the zero entropy state has been reached, whereas in the latter there would be no such residual motion. These statistical considerations are however believed to be inapplicable to the thermo-dynamic study of helium because, as far as heat vibrations are concerned, the atoms of any kind of helium under the nuclear theory must be considered as consisting of only three particles: a nucleus and two electrons.

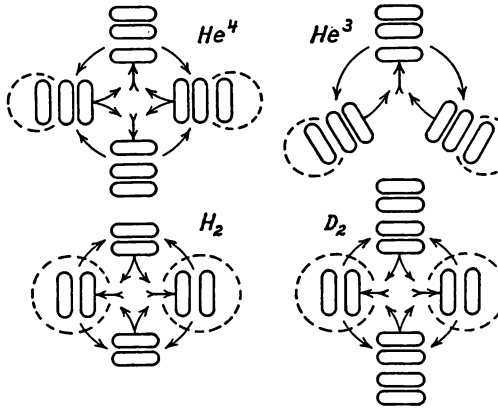

Fig. 11.—The helium atom and its so-called "lower isotope", as distinguished from true isotopes like those of hydrogen. If He^4 consists of a radial cluster of four neutrons, then He^3 would presumably consist of a radial cluster of three neutrons. If these are arranged as shown, then He^3 should be an inert gas similar to He^4 and should produce divalent positive ions in a similar manner. Most of its other physical properties would however be different from those of He^4 because of its lower degree of atomic symmetry. It should therefore be considered as a different chemical element, unless we change the definition of the word "isotope".

Furthermore the predictions made on the basis of the above statistical considerations have not been as successful as they should have been if the underlying principles were correct, and the following widely publicized prediction has been especially erratic:

It seems very likely that He^3 cannot exist in the liquid state at all. Such a liquid should have a vanishing dynamic viscosity and a high kinetic viscosity. Either we will have a liquid of entirely unheard-of properties, or the system will avoid the dilemma of the small and large viscosities by not liquifying at all, but will either freeze or stay a gas at vanishing pressure and temperature. (PHYSICS TODAY, August 1948)

Although He^3 has properties very different from those of ordinary helium, nevertheless the observed differences are not in the direction of the above prediction, but they are in accordance

with the writer's prediction under the vortex theory that "there cannot be any lower isotope of helium". ("ETHER AND MATTER", 1945, p. 69).

Notwithstanding its inappropriate name, He^3 cannot be an isotope of helium because isotopes of the same element must have at least approximately the same peripheral properties. The anomalous properties of He^3 are however satisfactorily accounted for under the vortex theory wherein He^3 is a polymer of three neutrons arranged on radial axes as shown in Fig. 11, as distinguished from He^4 which is a radial polymer of four neutrons. The vortex atom of He^3 therefore has a different geometric form and a lesser degree of symmetry than the vortex atom of He^4, which would necessarily give rise to a difference in peripheral properties and especially to a difference in magnetic moments. Under the nuclear theory all isotopes of helium would necessarily have exactly the same degree of symmetry in the peripheral structures of their atoms and should therefore be equally devoid of any magnetic moment.

The superfluidity of ordinary helium in the neighborhood of absolute zero, although inexplicable under the nuclear theory, can be satisfactorily explained under the vortex theory. The vortex atom of He^4 is a symmetrical structure with its neutrons arranged radially so as to leave exposed two peripheral electrons and two peripheral protons. Under thermal vibrations of appreciable intensity some of the electrons will become dissociated (by shedding of terminal vortex rings from the neutrons) so as to leave the atoms in a condition of partial ionization which will cause ordinary liquified helium to have its normal viscosity. Within a degree or two of absolutely zero, however, the atoms of He^4 are sufficiently quiescent to permit complete neutralization of the peripheral electrons by the peripheral protons *of the same atom.* Each atom of He^4 while in the superfluid state is therefore a self-contained entity, not electrically coupled to any of the adjacent atoms. Such a condition can never exist in He^3 because although the atoms of He^3 under the vortex theory have two peripheral electrons, they have only one *peripheral* proton and also a lesser degree of symmetry. The atoms of He^3 will therefore not be capable of such complete self-neutralization as the atoms of He^4. The reason why other inert gases like neon or argon do not exhibit superfluidity is probably because they pass into the solid state before the temperature becomes sufficiently low for complete self-neutralization. After He^4 has passed into the superfluid state it

will not solidify at all unless pressure is applied, which probably has the effect of dislodging the terminal vortex rings from the negative ends of some of the neutrons so as to leave the injured atoms positively charged and no longer completely self-neutralized.

A similar explanation can also be offered under the vortex theory for the increased electrical conductivity and for superconductivity in the neighborhood of absolute zero. Even at ordinary temperatures the electrical conductivity of metallic conductors increases as the temperature is lowered, and in certain metals and alloys the conductivity becomes infinite when temperatures within a few degrees of absolute zero are reached. Hg, Pb, Sn, Tl, Ta, CuS, TiC, VN, ZrC and ZrB exhibit superconductivity, but Au, Cu, Ag and Bi do not. The explanation of superconductivity however is not as simple as the explanation of superfluidity because the atoms of metals consist not only of helium groups but also of hydrogen groups in the form of valence bonds. Another complication is that in metals there may be two different kinds of peripheral electrons, namely those which form parts of the valence bonds and those which have been captured by ionized helium groups. We do not know which of these are responsible for metallic conduction, but there are reasons for believing that it is the free valence electrons of hydrogen groups which have not formed chemical bonds with other hydrogen groups.

In ordinary metallic conduction the moving electrons with their magnetic fields migrate through the interior of the metal, but if the metal passes into the superconducting state, the moving electrons and their magnetic fields will be crowded out from the superconducting material. The electrons will then glide along the surface of the superconductor while their magnetic fields will be entirely outside of the latter. The electrons will not completely leave the superconductor because the latter is now positively charged and exerts an electrostatic attractive force on the moving electrons.

It has been found experimentally that a superconductor will crowd out an impressed magnetic field of external origin, even if there is no electric current flowing along the superconductor. This seems to show that it is primarily the ether currents of the impressed magnetic field, rather than the electrons themselves, which are crowded out. This however makes no difference in the final result because the magnetic ether currents are interlinked with the moving electrons and will carry the electrons along with them.

The reason why a superconductor behaves in this manner is probably because the metal atoms have become wholly or partly self-neutralized in a manner similar to the self-neutralization of the atoms of helium while in the superfluid state. It seems that the effect of such self-neutralization is to make it difficult for the ether currents of the magnetic field to thread their way through the metal atoms or through the regions between adjacent atoms. The reason for this will be apparent when it is considered that self-neutralization is characterized by movement of the ether in closed circuits in the same atom so that the ether circulation of each atom will be distinct from that of every other atom. The ether currents of the magnetic field will therefore not find the necessary continuity of path and of direction of flow for threading their way through a superconducting material. Neither will they be able to get through between adjacent atoms because metals are generally not porous. Their atoms are bound to one another by their valence bonds and are thus kept in a state of compression because the actual volume of a metal atom is generally much smaller than the sum of the volumes which would be occupied by its hydrogen and helium groups if they existed separately.

Ordinary metallic conduction is always accompanied by the generation of heat because the moving electrons are at all times connected by means of their interlinked ether currents with the protons of adjacent metal atoms and during the movement of the electrons such connections are continually torn apart, which disturbs the atomic oscillators. In a superconductor however the moving electrons are on the outside of the metal and are not sufficiently close to the protons to become connected therewith so as to form atomic oscillators. Nevertheless, even in a superconductor, these moving electrons and their interlinked ether currents will be oriented in the direction of their movement and will therefore exhibit the usual magnetic field in the regions around the superconductor.

The above explanations which have been offered under the vortex theory are not available to the nuclear theory, nor does the nuclear theory have room for any additional element between hydrogen with atomic number 1 and helium with atomic number 2. Nevertheless the experimental evidence plainly shows that such an additional element does exist, and when theories and facts conflict, then the theories must be changed, and not the facts. The writer tried to warn the physics profession over twenty years ago that the nuclear theory does not rest on a sound foundation, but

they refused to pay any attention, and it will be interesting to see what they are going to do now with an "isotope" that does not behave like an isotope.

It will not do to pass this up as a trivial difficulty of no consequence which will be solved in the course of time. If a satisfactory explanation were possible under the nuclear theory, then it would have been found long ago, but no matter how hard we try, we cannot squeeze blood out of a turnip. Furthermore it is not a trivial difficulty but goes to the very foundations of the entire nuclear theory because the helium group or alpha particle has always been recognized as the most important structural unit of every atom except hydrogen and helium 3. Whether the physics profession will like it or not, the celebrated nuclear theory of atomic structure which has dominated atomic physics for nearly half a century must be considered as having been *disproved.* This should not come as any surprise to the physics profession because actually the nuclear theory has been disproved long ago by the numerous impossible arbitrary postulates which are necessary to support it, none of which are required by the vortex theory. The physics profession however has been so sure of its time-honored nuclear theory that an impartial appraisal of it was not to be expected. Why should they waste their time weighing the evidence in support of it when our confidence in it, as stated by Lawrence (1941), "rivals our confidence that the planets revolve about the sun", and when the nucleated structure of the atom, as stated by Moulton (1940), "is hardly more questionable than nearly everything that we accept as certain"?

The term "atomic nucleus" will probably continue to be used for many years because the nuclear theory was there first and has become deeply embedded in printed literature and in the thinking habits of physicists, but it will henceforth have a different meaning, or perhaps no meaning at all, and should therefore be relegated to the limbo of phlogiston and caloric. The experimental facts on which the nuclear theory is based do not require an atomic nucleus but only a structural center to which all parts of an atom are firmly connected, and such a structural center should not be designated by the inappropriate and misleading term "nucleus" which was originally introduced with a very different meaning. The continued use of this term would lead to confusion as to whether the entire inner skeleton of the atom or only its center of inertia is referred to. Let us not cling too tenaciously to the term "atomic nucleus" or the twentieth

century may eventually become known as the "nucleocentric age", in line with the heliocentric and geocentric ages.

This however should not be interpreted to mean that the nuclear theory should be eliminated from the textbooks. Theories serve different purposes, and in making practical calculations it may be necessary or desirable to use a simplified or symbolic representation rather than one that is strictly true to fact. A similar situation exists in the case of magnetism. Although the magnetic lines of force are probably nothing more than mathematical fictions, nevertheless they are so very convenient to use in making calculations that we could hardly get along without them. Even if it should eventually be found that we can get along without the nuclear theory, still it may take a long time to introduce the necessary changes of nomenclature, and during the transition period both theories should be presented in the textbooks. The best procedure for the immediate present would be to employ only such terminology as is equally applicable to both the nuclear theory and the vortex theory.

PERIODIC TABLE OF ELEMENTS

In the accompanying table the strongly positive elements are in groups I and II at the left while the strongly negative elements are in groups VI and VII at the right. Groups III and V contain the trivalent elements on the basic and acid sides respectively. Group IV contains not only the usual elements of the carbon group but also all the remaining elements. No attempt has been made to classify these remaining elements in separate groups but similar elements have been placed in vertical alignment whereever possible. The elements that are usually classified in group IV have been placed centrally in this group, which is the region of highest melting points and greatest hardness and density. As we move away from this central region the melting points (which are determined primarily by the number of valence bonds on the atoms) generally become lower until the right and left hand margins of the table are reached.

This table differs from most periodic tables in that it is based primarily on what are believed to be the actual structures of the atoms, rather than on chemical valence. If chemical bonding would consist merely of the transfer or sharing of electrons as taught by the nuclear theory, then the valence of an element would necessarily be a primary criterion in its classification. The vortex theory however has made it clear that there are several factors which may seriously disturb any simple numerical relationship between chemical valence and the number of hydrogen groups on the atoms. There may be a direct chemical union between two hydrogen groups *of the same atom*, or there may be a partial connection between several hydrogen groups so as to form a branched valence bond. Another possibility is that after some of the hydrogen groups have formed chemical bonds with other atoms, the remaining hydrogen groups may no longer be readily accessible from the outside. This may be the reason why all the rare earths have a valence of only three although most of them probably have more than three hydrogen groups on their atoms. Furthermore it is also possible that the two inert argon groups at opposite ends of each rare earth atom may divide the intervening space electrostatically into three zones so that other atoms which are in the process of combining with these rare earth atoms will have only three avenues of approach. Under such conditions there will not be much agreement between the chemical valence of an element and the number of hydrogen groups on its atoms.

The numerical designations 1, 2 and 3 at the left hand margin of the table indicate the number of structural centers on which

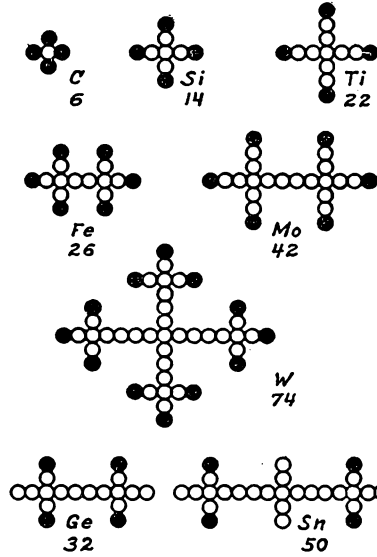

Fig. 12.—Typical atoms of Group IV. The abundance of peripheral hydrogen groups (valence bonds) and the scarcity of peripheral helium groups accounts for the high melting points of most of these elements. Thus carbon is the most refractory of all elements, tungsten has the highest melting point of any metal, and silicon, titanium, iron and molybdenum occupy positions of maximum height on the melting point curve.

None of the above named elements have any *peripheral* helium groups and their melting points therefore become higher as the number of hydrogen groups increases. On the other hand in the series Si, Ge and Sn the number of hydrogen groups remains constant while the number of peripheral helium groups progressively increases so that the melting points in this last series should become lower as the atomic number increases, which is actually the case. Similar relationships exist in other series of closely related elements, like Fe, Co and Ni.

the atoms of each horizontal row are built, while the designation 4 means that the atoms are formed of four branches connected to a common center. Every effort has been made to develop a structural scheme in which all the atoms are built up from the original structural center, but this does not seem possible. The krypton atom for instance with atomic number 36 is made up of 18 helium groups, and since 18 is an even number, this atom cannot have a single structural center and also the high degree of symmetry which inert gas atoms must be presumed to have. The krypton atom probably consists of two symmetrical halves as shown in Fig. 9, and if the krypton atom does not have any single structural center then the other elements in the neighborhood of krypton would probably also not have atoms with single structural centers.

No separate place has been provided for helium 3 because this element could be considered as being included under the general symbol "He" provided we change our definition of the word "isotope". A suitable change of definition could readily be made under the vortex theory but not under the nuclear theory. Thus under the vortex theory isotopes could be defined as substances having atoms composed of the same number of hydrogen and helium groups similarly arranged, but this definition is not available to the nuclear theory because the nucleated atom is not made up of hydrogen and helium groups but of a tiny central nucleus with orbital electrons.

MELTING POINTS IN DEGREES ABSOLUTE

1	H	14															
2	He	1	18	A	84	36	Kr	116	54	Xe	133				86	Rn	202
3	Li	459	19	K	335	37	Rb	312	55	Cs	301				87	Fr	
4	Be	1550	20	Ca	1124	38	Sr	1044	56	Ba	977				88	Ra	1230
5	B	2300	21	Sc	1470	39	Y	1080							89	Ac	
6	C ———	4500	22	Ti ———	2000	40	Zr	1970	57	La	1100	72	Hf	1970	90	Th	2120
7	N	63	23	V	1980	41	Cb	2220	58	Ce	913	73	Ta	3280	91	Pa	
8	O	55	24	Cr	1890	42	Mo ———	2890	59	Pr	1210	74	W ———	3640	92	U	1420
9	F	50	25	Mn	1530	43	Tc		60	Nd	1110	75	Re	3370	93	Np	
			26	Fe ———	1806	44	Ru	2720	61	Pm		76	Os	2970	94	Pu	
10	Ne	24	27	Co	1750	45	Rh	2230	62	Sm	1570	77	Ir	2720	95	Am	
			28	Ni	1725	46	Pd	1830	63	Eu		78	Pt	2030	96	Cm	
11	Na	371	29	Cu	1356	47	Ag	1234	64	Gd		79	Au	1336	97	Bk	
12	Mg	924	30	Zn	692	48	Cd	594	65	Tb		80	Hg	236	98	Cf	
13	Al	932	31	Ga	303	49	In	428	66	Dy		81	Tl	577			
14	Si ———	1690	32	Ge	1230	50	Sn	505	67	Ho		82	Pb	600			
15	P (red)	863	33	As	1088	51	Sb	904	68	Er		83	Bi	544			
16	S	386	34	Se	493	52	Te	726	69	Tm		84	Po				
17	Cl	172	35	Br	266	53	I	387	70	Yb		85	At				
18	A	84	36	Kr	116	54	Xe	133	71	Lu		86	Rn	202			

PERIODIC TABLE

nH 01	O	I	II	III	IV	V	VI	VII	O
1a	He 2	Li 3	Be 4	B 5	C 6	N 7	O 8	F 9	Ne 10
1b	Ne 10	Na 11	Mg 12	Al 13	Si 14	P 15	S 16	Cl 17	A 18
1c	A 18	K 19	Ca 20	Sc 21	Ti 22				
2a					V Cr Mn Fe Co Ni 23 24 25 26 27 28				
2b		Cu 29	Zn 30	Ga 31	Ge 32	As 33	Se 34	Br 35	Kr 36
2c	Kr 36	Rb 37	Sr 38	Y 39	Zr Cb Mo 40 41 42				
3a					Tc Ru Rh Pd 43 44 45 46				
3b		Ag 47	Cd 48	In 49	Sn 50	Sb 51	Te 52	I 53	Xe 54
3c	Xe 54	Cs 55	Ba 56	La Ce Pr Nd Pm Sm Eu Gd 57 58 59 60 61 62 63 64 Tb Ds Ho Er Tu Yb Lu 65 66 67 68 69 70 71					
4a					Hf Ta W Re Os Ir Pt 72 73 74 75 76 77 78				
4b		Au 79	Hg 80	Tl 81	Pb 82	Bi 83	Po 84	At 85	Rn 86
4c	Rn 86	Fr 87	Ra 88	Ac 89	Th Pa U Np Pu Am Cm Bk Cf 90 91 92 93 94 95 96 97 98				

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